2014

SECURING FOOD AND LIVELIHOODS: OPPORTUNITIES AND CONSTRAINTS TO SUSTAINABLY ENHANCING HOUSEHOLD FOOD PRODUCTION IN SANTA FAMILIA VILLAGE, BELIZE

Siobhan B. Lozada
The University of Montana

SECURING FOOD AND LIVELIHOODS: OPPORTUNITIES AND CONSTRAINTS TO SUSTAINABLY ENHANCING HOUSEHOLD FOOD PRODUCTION IN SANTA FAMILIA VILLAGE, BELIZE

By

SIOBHAN BURMA LOZADA

Latin American Studies, University of California at San Diego, 2008

Thesis presented in partial fulfillment of the requirements for the degree of

Master of Science

in Resource Conservation, International Conservation and Development

University of Montana
Missoula, MT

April 2014

Approved by:

Sandy Ross, Dean of the Graduate School
Graduate School

Stephen F. Siebert, Chair
Department of Forest Management

Dane Scott, Co-chair
Department of Society and Conservation

Sarah J. Halvorson
Department of Geography

Joshua Slotnick
Department of Environmental Studies

ABSTRACT

Rural households play an active role in reorganizing their livelihood strategies to respond to external stresses and shocks. What is unclear is the extent to which rural households can remain resilient in the face of continued external stresses and how policy actions at larger scales can more effectively encourage rural food and livelihood sustainability. Economic and ecological stresses and shocks have negatively impacted livelihood security and wider economic stability in Belize. This has increased the number of people below the poverty line to 41.3 percent, who remain disproportionately located in rural areas. With a high degree of import dependency, global food price surges have resulted in direct pass through effects on domestic prices, creating food price inflation of up to 22.8 percent between 2006 and 2009. Within this context, this study assesses the state of livelihood security in a village of the Cayo district by assessing the quality of household capital assets, including human, financial, natural and social capital. Semi-structured face-to-face interviews were conducted in 2012 using a random sample of 64 households. Participant observation, key-informant interviews, the use of secondary sources and extra-local interviews with government officials were also employed to gain deeper insight into the complexity of the rural environment and institutional policies related to food security and sustainable agricultural development.

Results show high levels of livelihood diversification among both grain farmers and non-farming households. No significant difference existed between total household median incomes. However, the median income of non-grain male household heads is significantly greater than that of grain farmer male householders ($U = 1393$, $n_1 = 43$, $n_2 = 16$, $p < .05$). Part-time farming households maintained the highest number of livelihood strategies compared to non-grain households, with a median of 4 to 3 respectively ($U = 506$, $n_1 = 11$, $n_2 = 48$, $p < .0005$). Compared to non-farmers, part-time farmers are disproportionately engaged in day labor as a primary income strategy, where pay is lower and work is less reliable ($Chi = 57$, $df = 1$, $p < .01$). Human capital is low among both household types, with 65 percent of non-farming male householders receiving no education above the primary school level, while all grain farmers received no education above the primary school level ($Chi = 59$, $df = 1$, $p <$

.01). Domestic and foreign remittances did not impact the majority of participants, as only 28 percent reported they received, or would receive, some amount of extra-household monetary support. Yet, the median value of out-country remittances were significantly greater for non-farmers compared to grain farmers ($U = 21.00$, $n_1 = 4$, $n_2 = 3$, $p < .05$). Despite these strategies, financial capital remains constrained, as over 75% of households are unable to save money, and the large majority of working females worked out of necessity. In addition, nearly two thirds of households have reduced meal size in recent years, with no significant difference between household types.

Nearly three quarters of all householders valued home gardens as a mode to adding diversity to the diet and improving health or reducing purchasing costs. Among grain farmers, 94 percent stated that grain farms provided their family with food, where 62.5 percent indicated risk management, specifically, as their reason for farming. This proportion rises to 83.3 percent when looking at white corn producers exclusively. When asked if farming has become more difficult, less difficult, or the same compared to the past, 62.5 percent of grain farmers stated that agriculture in Belize has become more difficult ($Chi = 6.5$, $df = 2$, $p < .05$). Biophysical constraints among both household types include vulnerability to waterlogging and drought, soil fertility and pest problems. Input costs are also of concern, while grain farmers faced additional transaction risk. Furthermore, land tenure insecurity is widespread. To compound the problem, social capital is also weak given disillusionment with formal organizing, where exclusionary policies by the local cooperative further restrict access to relevant low-cost and low-input technologies. Expanding access to sustainable technologies through participatory research and extension is recommended. However, greater access to technology alone is insufficient for sustaining intensification that can ensure resilient food and livelihood strategies. Reducing costs and risk through secure access to productive resources, markets, and financial services in a manner that accounts for heterogeneity in farming systems and local food security priorities are also essential. To this end, and with attention to national-level social and economic conditions, a pro-poor agricultural growth strategy is considered within a dynamic food sovereignty framework.

Keywords: Belize, Sustainable Agriculture, Small Farmers, Sustainable Rural Livelihoods, Subsistence Farmers, Agricultural Development, Political Agroecology, Local Food Systems, Adaptive Capacity, Food Sovereignty.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to my principle advisor, Steve Siebert, for his guidance and feedback in the completion of my thesis. Your constructive comments greatly improved the quality of this analysis. I am also grateful to Dane Scott for his professional support and warm encouragement. I further acknowledge the Provost and the Mansfield Ethics and Public Affairs Program for financially supporting this work. I give my upmost thanks to my mother for continuously inspiring my journey by reminding me what true strength, intelligence and wisdom looks like. To my professors throughout my academic career for your dedication to developing the mind and spirit of students everywhere. To my close friends for your heartfelt care and those indispensable instances of laughter. To all the families and farmers I have had the privilege of meeting, I express special thanks for diversifying my understanding through your steadfast insistence on my re-education. To my partner who kept me balanced through many memorable excursions during the interviewing period, as well as fed throughout my writing days in the bush, you are the power that drives my convictions. To the forest, flora and fauna, for nourishing the body and mind, reminding us what truly matters; it is to you to which I dedicate this work.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES AND PHOTOGRAPHS

LIST OF ABBREVIATIONS

ADLI	--	Agricultural Demand-Led Industrialization
AOA	--	Agreement on Agriculture
BMDC	--	Belize Marketing and Development Corporation
BRADS	--	Belize Rural Area-based Development Strategy
CBI	--	Caribbean Basin Initiative
CARDI	--	Caribbean Agricultural Research and Development Institute
CARICOM	--	Caribbean Community and Common Market
CARICOM-EPA	--	Caricom and the European Union Economic Partnership Agreement
CARICOM-SICA	--	Caribbean Community and the Central American Integration System
CATIE	--	Centro Agronómico Tropical de Investigación y Enseñanza
EIA	--	Environmental Impact Assessment
FAO	--	Food and Agricultural Organization of the United Nations
FO	--	Farmer Organization
FTA	--	Free Trade Agreement
GOB	--	Government of Belize
LDC	--	Less Developed Country
MAF	--	Ministry of Agriculture
MIC	--	Middle Income Country
NFNSC	--	National Food and Nutrition Security Commission
NRM	--	Natural Resource Management
PES	--	Payments for Ecosystem Services
PRE	--	Participatory Research and Extension
PPAG	--	Pro-Poor Agricultural Growth
R&D	--	Research and Development
SA	--	Sustainable Agriculture
SAI	--	Sustainable Agricultural Intensification
SRL	--	Sustainable Rural Livelihoods
SVE	--	Small and Vulnerable Economy
WTO	--	World Trade Organization

CHAPTER 1: INTRODUCTION

1.1 The Nature of Economic and Ecological Stresses and Shocks in Belize

Belize is a middle income country (MIC) located in Central America bordering Mexico to the North and Guatemala to the West and South, with the Caribbean Sea to the East. For a small country of only 22,700 square kilometers, Belize holds a high degree of biodiversity. This natural abundance is complemented by the country's ethnic diversity as it is home to Mestizos, Creoles, Mayans, Garifuna, Mennonites, East Indians, and Chinese, populations that remain geographically distributed in ways that reflect the history of the country from British colonialism to political independence in 1981 (Barry 1990, Bolland 2003). While the country enjoys a relatively high GNI per capita of USD $4,490.00, not only is wealth skewed toward urban areas, but per capita income has been declining every year since 2002 (World Bank 2013, FAO and GoB 2011a).

With a population of only 333, 200, Belize faces serious development challenges. The 2009 Country Poverty Assessment Report reveals that the number of people below the poverty line has increased from 33.5 percent in 2002 to 41.3 percent in 2009, with an additional 14 percent being vulnerable to poverty. This rise in poverty has been attributed to reductions in preferential trade agreements[1] amid high external debt payments[2], compounded

[1] Preferential tariff treatment has been afforded to Belize under different multilateral agreements, including the Caribbean Basin Initiative (CBI) that negotiates trade between CARICOM countries and the USA, CARICOM-EPA with the European Union, and CARICOM-SICA with Central America. Within CARICOM, Belize receives substantial preferences against import competing goods from outside the regional trade block, though reductions in CARICOM's common external tariff under new FTA and WTO commitments will erode current advantages. As a result of predicted losses, 'Aid for Trade' is now provided to upgrade the county's trading infrastructure to new global trade standards (WTO 2010).

by natural disasters and a worldwide economic recession (NHDAC 2010). Due to negative growth rates between 2007 and 2009 and a sharp rise in unemployment, for the first time in history poverty is now more evenly spread geographically, ethnically, and sectorally in Belize[3]. Given the country's macroeconomic situation and current population trends, the IMF's Baseline Scenario projects economic stagnation in real per capita income at least until 2019[4] (IMF 2008, NHDAC 2010).

Belize's vulnerability to natural and economic disasters has direct and indirect effects on domestic food security. Natural disasters, particularly hurricanes and flooding, affect the agricultural sector by reducing yields and promoting crop disease in both staple grains and traditional export commodities critical to foreign exchange generation[5] (MAF 2003a, FAO and GOB 2011b, Ramirez et al 2013). With half of the rural population depending on the agricultural sector as a central source of livelihood, output declines and deteriorating infrastructure from extreme weather events threaten yields, hamper marketing, constrain incomes, and increase the future cost of production, while short-term scarcity result in higher consumer prices (NHDAC 2010). Projected climate change impacts suggest increasing droughts and tropical storm intensities (Richardson 2009). External economic stresses, such as deterioration in preferential trade as well as declines in the value of traditional export commodities, further destabilize the narrow export-oriented economy, contract capital

[2] Belize's current external debt to GNI ratio stands at 96 percent (World Bank 2013). While structural adjustment in 2007 allowed for a 21 percent decrease in Belize's debt burden from 47 percent of government expenditure, mounting debt obligations and increasing interest rates are expected to substantially constrain public sector investments in the medium and long term (WTO 2010, NHDAC 2010).

[3] Declines in employment in the textile, oil, citrus, fishing, and tourism industries were 74, 48, 45, 34, and 26 respectively. Overall unemployment officially stands at 13.5 percent (NHDAC 2010).

[4] The population growth estimate used in this analysis is 3.7 percent, calculated for increased immigration from neighboring countries (IMF 2008).

[5] Agriculture, including forestry, generates 66 percent of Belize's foreign exchange earnings (WB 2009)

spending and encourage public debt accumulation, affecting producers and consumers alike in both the short and long-run (MAF 2003a, Deep Ford and Rawlins 2007, Bernard and Iyare 2008).

To compound the problem, structural dependency on imported food and agricultural inputs not only absorb limited foreign exchange earnings, but also strain the purchasing power and productive capacity of households whose income levels are not keeping pace with rising food and input costs. With a high degree of import dependency, global food price surges have resulted in direct pass through effects on domestic prices, creating food price inflation of up to 22.8 percent between 2006 and 2009[6] (Deep Ford and Rawlins 2007, Mendoza and Machado 2009, SIB 2009a). High demand for food and feed has driven greater grain exports to neighboring countries, causing real scarcity as well as price gouging[7]. Food price inflation in 2008 alone increased by 13.3 percent, the highest in 25 years, primarily due to price surges in food staple, including rice, flower, bread, milk, cooking oil, eggs and chicken[8] (see Appendix A) (SIB 2009b, CBB 2009). With over one third of all households under the poverty line, and disproportionally in rural areas[9], expenditures on food are absorbing more than 50 percent of rural household income, with the lowest quintile of the population spending 67 percent of their income on food (NHDAC 2010). Indigence has

[6] The contribution of food price inflation on headline inflation in Belize (102.2%) is the highest in the Caribbean. Had it not been for food inflation, overall inflation would have been negative (Mendoza and Machado 2009).
[7] Gustavo Tush, Acting Director, Central Farm, personal communication, 10 November 2012; Robert Harrison, Director of Extension, personal communication, October 31, 2012.
[8] The price of flour, rice, and chicken, for example, rose 50.4, 34.9, and 15.8 percent respectively (SIB 2009b). On the other hand, traditional export crops, including sugar, citrus, and bananas, have not witnessed comparable price increases to offset the economic impact of higher food costs (Mendoza and Machado 2009).
[9] While 28 percent of the urban population falls under the poverty line, poverty in rural areas is 55 percent, and while 21 percent of urban households are considered poor, the number rises to 43 percent in rural areas. That is, out of the entire population and all households living under the poverty line, 66 and 63 percent live in rural areas, respectively (NHDAC 2010).

reached 16 percent of the population, with common nutritional deficiencies in the country being in vitamin A, calcium, potassium, iron and folate[10] (NHDAC 2010, Khan et al. 2009). In rural areas, children are more likely to be stunted and underweight (GoB and UNICEF 2006). Future austerity measures, predicted to lead to substantial cuts in social spending by 2019, further threaten food and livelihood security in the country[11] (NHDAC 2010).

With limited opportunity in formal wage-based employment and a weak social safety net, the relative value of household food production to secure greater access to food and income in rural areas may be increasing in importance. However, while higher food prices may offer incentives for households to increase production for subsistence and commercial purposes, the cost of agro-inputs, such as fertilizers and fuel, undermine the productive capacity of cash-strapped households. Global food price surges in 2008 not only resulted in higher consumer prices, but also led to double digit inflation in fertilizer imports and fuel that have yet to decline significantly[12] (FAO 2009, FAO and GOB 2011a). The Food and Agricultural Organization of the United Nations (FAO) warns that higher production costs limits the ability of small and medium-sized farmers, who make up 57 percent of the country's food producers, from participating in Belize's agricultural development[13] (FAO

[10] The poverty line is calculated using the Minimum Cost Daily Food Basket (MFB) based on district-level food costs, in addition to a non-food expenditure allowance. It is calculated by multiplying the local MFB by the reciprocal of the proportion of total household expenditure spent on food by the 40% of the population with the lowest per capita expenditures. Those below this line are considered to be living in poverty, while non-poor household are considered those having expenditures over 25% of this line. Indigence, on the other hand, is defined as those unable to adequately feed themselves (i.e. those unable to afford the Minimum Cost Daily Food Basket) (NHDAC 2010).

[11] As of 2009, resources allocated to social protection amounted to 5.7 percent of GDP (NHDAC 2010).

[12] Diesel fuel reached 11.74BZ per gallon and regular fuel reached 11.40 BZ per gallon in August of 2008. Fuel prices for diesel and regular grade currently stand at 9.99BZ and 10.97BZ respectively (MF 2012a, MF 2012b).

[13] 24 percent of food producers cultivate less than 5 acres, while 33 percent cultivate between 5 and 20 acres (Belize Farm Registry 2002). While the Belize Farm registry estimated a total of 9,697 total farms in the

and GOB 2011a, Belize Farm Registry 2002). Yet, government interventions to alleviate the impact of price surges have overwhelmingly supported poor consumers over capital-poor producers[14], reflecting historical responses by the government of Belize (GoB) aimed at curbing urban unrest at the expense of the rural poor (Demeke et al 2009, CBB 2010, Moberg 1992).

Consequently, both food and agro-input prices remain high, while greater market liberalization in the agricultural sector is expected to weaken the competitive capacity of Belize's family farms (Mendoza and Machado 2009, SIB 2012, WTO 2010, MAF 2003a). Belize is now facing a situation where rising production and transaction costs and increased global competitiveness threaten to displace small and medium size producers from the sector. Practical changes in agricultural practices to increase both economic and ecological sustainability have been advocated as a principle means to ensure greater competitive advantages by Belizean farmers (MAF 2003a, b, Paredes 2010, FAO and GOB 2011a). Deteriorating soil conditions and weed and pest infestation also pose productive challenges for subsistence-oriented producers who often rely on surrounding forests to cultivate food, which has raised the value of low-cost and low input practices for sustainably enhancing local food systems (Kellman and Adams 1970, Arnason et al 1982, Arnason and Lambert 1982, Lambert and Arnason 1986). It is in this economic, social, and ecological context that improved natural resource management is viewed as central to safe guarding rural food systems and livelihood security in Belize.

---

country, preliminary results from the 2011 Agricultural Census indicate a substantially higher number of 19,236 total farms (Tate 2013).

[14] The government of Belize attempted to control prices through domestic trade restrictions, reductions in import tariffs and custom fees, and the zero-rating of the General Sales Tax (GST), currently at 12.5 percent, on essential food items and agricultural supplies, including fertilizers (CBB 2010, FAO 2009).

1.2 Research Objective

Rural households play an active role in reorganizing their livelihood strategies to respond to external stresses and shocks (Chambers and Conway 1991). What is unclear in the context of Belize is the extent to which rural households can remain resilient in the face of continued economic and ecological impacts and how policy actions at larger scales can more effectively encourage rural livelihood sustainability. This study seeks to investigate the opportunities and constraints to sustainably enhancing food production practices in a village in western Belize. As such, it aims to develop context-specific policy recommendations for improving socio-ecological resiliency in a manner that achieves sustained access to food through direct (i.e. food production) and/or indirect (i.e. sale of crops) means. The central research question is: How can rural households achieve sustainable food production as a mode to enhancing household food and livelihood security?

There are three central objectives this study seeks to address. First, an investigation into the livelihood strategies of rural households must be conducted in order to comprehend how both grain and non-grain producing households generate income and secure food. That is, what are the central and alternative strategies in which rural households engage to make a living? By understanding how households utilize their assets, capabilities, and opportunities, one can grasp how the livelihood pathways of different household types could potentially be sustainably enhanced through policy actions at different scales. In the process, such an analysis will highlight the unique features of rural households, a case study including those

that produce food in home lots, as well as those maintaining grain farms on extra-lot land for subsistence and/or commercial purposes. Such an investigation is important, because it identifies who grain producers are, highlighting specific livelihood strategies and conditions, which may provide insight into the opportunities and constraints to sustainably enhancing local grain production systems in addition to on-lot food production practices.

Second, this study documents current food production practices both on home lots and on farm sites to develop an understanding of local food systems, the value of such practices, and the perceived obstacles to improving household food production capacity. In the process, this study documents the extent to which rural households produce staple grains -specifically corn, rice and beans – and other crops for family consumption, as well as the degree to which food surpluses are sold in the market as a central or alternative source of income. Because the extent of family food production can vary with changes in off-farm income opportunities, as well as fluctuations in consumer/producer prices and climate conditions, measuring the frequency of household food production remains elusive. The reasons for which households produce food is also not fully understood. While estimates are being updated for the country, empirical data on farming practices, especially in the Cayo district, are not only scarce but largely outdated, which affect attention to and support for small farmer development initiatives in food and agricultural policies. Therefore, documenting the nature and recording the frequency of current grain farming activities is important to understand how livelihood security and village food production practices can be sustainably enhanced.

The third objective of this study is to examine national food and agricultural policies in order to assess how subsistence and commercially oriented agriculture have been conceptualized and incorporated into food security and agricultural development initiatives. This will provide the larger policy context within which local food production practices are carried out and allow for an assessment of how such initiatives can more effectively incorporate household economic and ecological sustainability using a sustainable rural livelihoods (SRL) framework. As such, this study will provide practical policy recommendations as they relate to village food and livelihood security and related natural resource management. It will also add to the ongoing debate over the role of the state in driving pro-poor agricultural growth and sustainable agricultural intensification (SAI), as well as contribute insight into how the multifunctional role of agriculture might be addressed in developing a more dynamic and resilient national food system.

1.3 Scope of the Research

The scope of this investigation is limited to the village of Santa Familia located on the western end of the Cayo district. This location was chosen to complement studies on food security and subsistence farming concentrated in the southern districts of Stan Creek and Toledo (Moberg 1991, Steinberg 1998, Levasseur and Oliver 2000, Zarger 2009, Reeser 2013). Inferences taken at the village-level provide household-level data relevant to the particular cultural and ecological environment in Santa Familia. However, this case study may provide insights into the dynamics of rural livelihoods in other rural villages in the country.

1.4 Research Overview

This thesis is broken into eight chapters. In Chapter 1, the author introduced the economic and ecological conditions facing rural households in rural Belize. Chapter 2 reviews the literature on rural livelihood sustainability, the diversity of small farmer food production practices, and current food and agricultural policies in the country. Chapter 3 discusses the methodology used in collecting and analyzing the empirical data. Chapter 4 describes the study site by giving an overview of the local food culture and agricultural setting within its wider district-level socioeconomic context. Chapter 5 reports the results covering village livelihood strategies, asset security, agricultural practices and the constraints noted to improving local productive capacity. Chapter 6 discusses the results and assesses the opportunities and constraints to sustainably enhancing household food systems based on the nature of livelihood assets (e.g. human, financial, social, natural, and physical) and on-farm/off-farm livelihood orientations. This chapter also highlights key areas for policy action to maximize the availability, access and utilization of sustainable agricultural (SA) technologies that can strengthen several livelihood assets upon which household's depend. Chapter 7 concludes with a brief overview of principal findings and policy imperatives while identifying entry points for future research.

CHAPTER 2: LITERATURE REVIEW

The following literature review covers three themes important to this study (see Figure 1). The first examines the four dimensions of the food security concept and reviews the analytical framework embedded in the Sustainable Rural Livelihoods (SRL) approach. The second explores the livelihoods of household food producers in developing countries in order to grasp the diversity within livelihood strategies, including food production practices, before highlighting a few widely recognized driving factors of SAI. In the process, the value of subsistence food practices in development literature is assessed to gain an understanding of the importance of direct access to food in institutional policies aimed at reducing rural poverty. The third theme reviews current food and agricultural policies in Belize, which are contrasted with earlier strategies and alternatives development theories that will later be referenced to identify points of entry for relevant policy reforms informed by the empirical data.

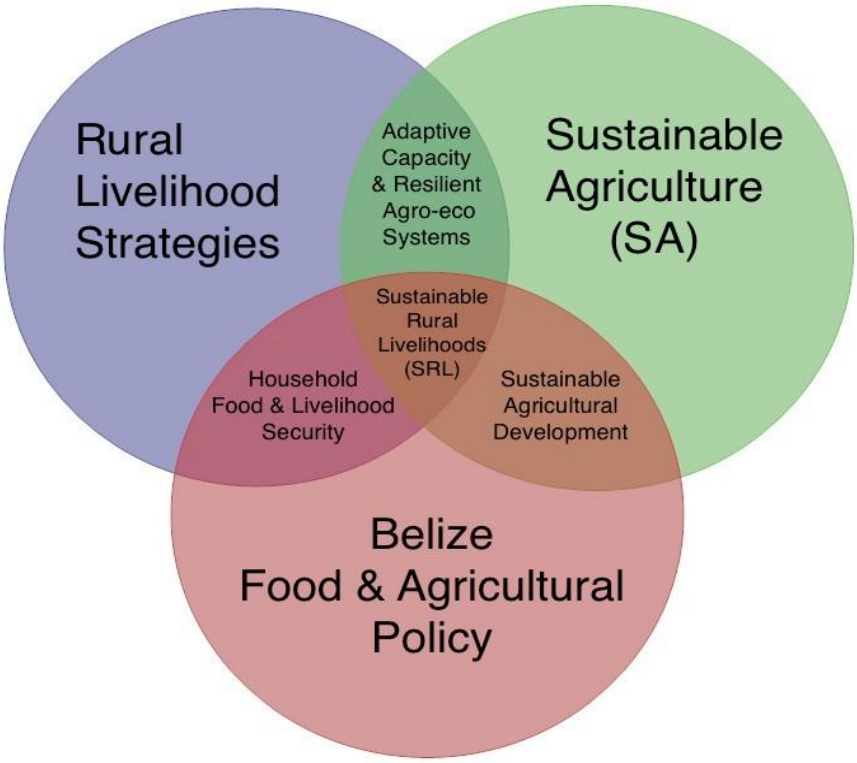


Figure 1: Three Dimensions of Research Focus

2.1 Food Security and Sustainable Rural Livelihoods

The food security concept

Food security, as an institutionalized universal concept encompassing both food and nutrition security, was conceived in 1974 by the Food and Agricultural Organization of the United Nations (FAO). Today, the term defines a situation where:

All people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (WSFS 2009: 1)

As a conceptual ideal, the idea of food security has evolved into greater complexity over time in an attempt to maintain its applicability to various policy frameworks and technical approaches focusing on the producer and/or consumer at different scales.

The current composition of the food security concept includes four key pillars that are regarded as indispensable components to the food and nutrition security framework: availability, access, utilization, and stability. These four dimensions must be simultaneously fulfilled in order to satisfy the condition of food security. Ensuring food *availability* implies that there is a sufficient supply of food of adequate quality to meet the needs of the unit of analysis in question and is necessarily linked to agricultural production and trade. Food *access*, on the other hand, refers to the ability of the individual, household, or population to obtain appropriate foods for a nutritious diet (Stamoulis and Zezza 2003). Access can be secured by the local production of food (i.e. direct access) as well as through social networks and food purchases (i.e. indirect access). The former requires rights to adequate resources, or entitlements, while the latter is obtained by exchange, as a gift, or through the market where sufficient purchasing power is required (Sen 1981, Maxwell and Smith 1992).

The utilization and stability components of the term are emphasized to ensure that food availability and access are secure and improve nutritional status and physiological wellbeing over the long run. Food *utilization* highlights how intra-household social relations, cultural choices, and the knowledge base of food consumers affect the sufficient consumption of adequate foods to satisfy the nutritional needs of all members of the household. This component also reveals the importance of non-food inputs related to food consumption, including clean water, sanitation, health care and the ability to biologically

utilize the nutrients consumed. Food *stability* underscores the idea that food security is optimally established when the availability, access, and utilization of food resources are sustained over time (Stamoulis and Zezza 2003). This dimension recognizes the potential destabilizing impact of external forces and focuses on improving resilience in the structure of food systems to effectively reorganize and resist ecological, economic, and political stresses and shocks (Frankenberger et al 2012).

The four dimensions of the food security concept reveal that ensuring individual and household food security is dependent upon sustaining direct and indirect modes of food access through actions carried out on different scales, including the individual, household, community, subnational, national, and global scale. As such, food security is a multifaceted and multisectoral concept, where those focused on monitoring and improving food security specialize in addressing particular aspects of the problem informed by the local context. For such reasons, the focus of analysis often rests on the nature of *food insecurity*, which is broadly described as "a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life" (FAO, WFP and IFAD 2012: 57). Food insecurity, often resulting from economic conditions of poverty, can exist on a transitory or chronic basis, where *vulnerability* to food insecurity is understood as being at particular risk of becoming food insecure, including deterioration in the mechanisms that affect one's ability to cope in difficult times (Alwang et al 2001).

Rural livelihood systems

The Sustainable Rural Livelihoods (SRL) approach to food security and poverty reduction was developed in the 1990's by Robert Chambers and Gordon Conway (1991) and Ian Scoones (1998), among others, as a local-level alternative to single-sector development initiatives. It has helped to refine the dimension of food access and utilization by placing particular attention on local livelihood perspectives and practices at the household level, the social unit whereby food is accessed. The framework focuses on the dynamic between household assets, strategies, and institutional processes that impact the sustainability of rural livelihood systems over time (see Figure 2).

A *livelihood* refers to the way people use their assets, capabilities, and activities to secure adequate stocks and flows of food and cash to meet basic needs. The five principle capital assets that are assessed in evaluating a household's level of sustainability are human (i.e. skills, knowledge, labor power), financial (i.e. income, savings, remittances, pensions), social (i.e. formal and informal networking capacity, access to services, the use of moral claims upon institutions), natural (i.e. the quality of land and water resources, ecosystem services), and physical (i.e. producer inputs, adequate infrastructure, information systems) (DFID 1999). A livelihood is considered secure when there exists sustained access to income-generating activities and natural resources, including alternative strategies for offsetting risk and easing shocks. A livelihood is considered *sustainable* when one's assets, capabilities, and activities can be strengthened without undermining the ecological and social base upon which they depend (Chambers and Conway 1991). Sustainable livelihood security ensures local households and communities are *resilient*, or able to resist and recover from the

convergence of external stresses (i.e. impacts that are slow in formation) and shocks (i.e. impacts that are sudden and unpredictable) (Chambers and Conway 1991, Scoones 1998).

The concept of human capabilities has developed as an alternative to the usage of economic indicators alone in assessing wellbeing. Amartya Sen (1984) and Martha Nussbaum (1992) have been at the helm of developing the idea of human *capabilities*; considered the result of specific combinations of human functions to which an individual, or household, has access for developing the capacity to live a fuller life. These capabilities highlight the attributes of social development acquired through such means as education and health that, if accessible and utilized, can lead to greater capacity to aspire and live a long life with adequate nourishment, and to reason and plan one's life with consideration for the lives of others, including non-humans and the natural world (Nussbaum 1992). The SRL framework pays special attention to how a dynamic set of capabilities can help strengthen a household's capacity to anticipate and respond to changes in the economic, ecological, social or political environment (Chambers and Conway 1991, Scoones 1998, Bebbington 1999).

The third component, livelihood *activities*, refers to the combination of on and off-farm strategies that individuals and households employ to make a living and manage risk. Not only do these depend on one's current assets and capabilities, but they are also shaped by seasonal changes, the household's domestic cycle, and institutional processes at larger scales. Transforming structures, which include institutions, organizations, policies, and legislation, play an active role in shaping access to resources, and terms of trade; thereby influencing the direction of livelihood *pathways* within which households engage and evolve (DFID 1999,

Scoones 1998). Understanding the multiple attributes that make up livelihood systems, and the micro and macro factors that affect them, can reveal processes of social and political exclusion, which affect one's level of vulnerability and capacity to maintain resilience in face of new stresses and shocks (Chambers and Conway 1991, Chambers 1994). In this regard, the SRL approach not only accommodates for household strategies and perspectives in rural development practice through local-level field work, but as an analytical approach, necessitates thoroughgoing political critique at larger scales. As Ian Scoones (2009) writes: "livelihood perspectives must look simultaneously at both structure and agency and the diverse micro- and macro-political processes that define opportunities and constraints" (186). In this way, the SRL framework grasps how livelihoods are constructed and perceived, building off the knowledge base and interests of local people in the process of investigating the complexity of the rural environment.

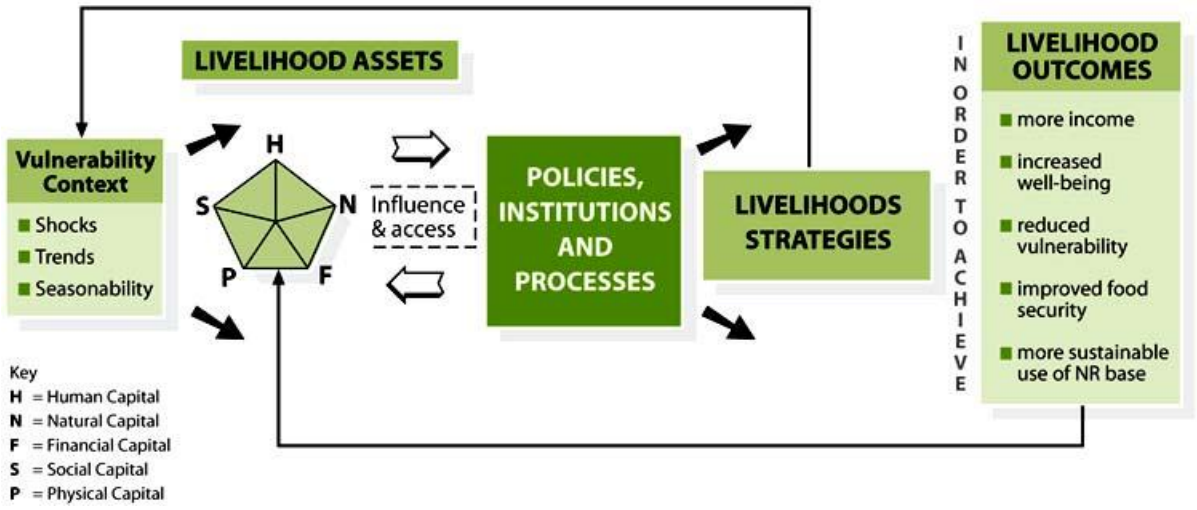


Figure 2: Sustainable Livelihoods Framework
Source: Department for International Development (1999)

Sustainable food and livelihood security

Rural households face a diversity of pressures and respond to them in complex ways. Because securing access to adequate food is often one of several competing priorities in times of stress, where one's combination of coping mechanisms can function to preserve critical assets and thus future food security or lead to their deterioration[1], looking at food and livelihood security together is often more indicative of a household's ability to maintain and improve household resources and wellbeing over time (Maxwell 1996). The livelihoods approach to food and nutrition security goes beyond quantitative supply and access indicators to understand how livelihood strategies in particular locales respond to perceived risk and uncertainty. Simon Maxwell and Keith Wiebe (1999) defined household food security as:

"A state of having secure and sustainable access to sufficient food for an active and healthy life" (825).

In this respect, not only is secure and consistent access to food through physical, social and economic means a precondition, but attention to how the nature of food access impacts livelihood resources, such as natural capital, over time is paramount (Frankenberger and Goldstein 1990, Wiebe 1994).

Rural livelihoods literature focusing on household food security and the environment show that sustainable agroecosystems are essential to enhancing several capital assets upon which rural households depend. Gordon R. Conway (1986) describes an agroecosystem as an

[1] Coping strategies, as opposed to *ex ante* risk management strategies, are a diverse set of responses for mitigating the immediate effects of external pressures on livelihood resources. They can include changes in cropping practices, increased petty commodity production, use of inter-household transfers and loans, use of credit from merchants and money lenders, food rationing or eating less nutritious foods, collection of wild foods, migration to towns in search of urban work, taking children out of school and the sale of productive assets (Corbett 1988 cited in Frankenberger and Goldstein 1990).

"ecological system modified by human beings to produce food, fibre, or other agricultural products" (95). Four key properties underlie the functioning of agroecosystems: productivity, stability of production, sustainability and equitability (in goods and services) (Conway 1986, Conway and Barbier 1988). Sustainability in agriculture has been defined by Miguel Altieri (1987) as "the ability of an agroecosystem to maintain production through time, in the face of long-term ecological and socioeconomic constraints." Sustainable agricultural (SA) practices, therefore, reduce and make more efficient use of external non-renewable inputs in order to optimize conservation of soil, energy, water and biological resources, while also minimizing financial input costs for land users (Altieri 1987, Pretty 1995, Gliessman 2006).

Examples of SA technologies include crop rotations that incorporate nitrogen-fixing trees and shrubs along with organic on-farm inputs, such as manures, mulches and cover crops to reduce weeds, optimize nutrient cycling and maintain soil health and fertility; physical land manipulations, such as terracing, raised fields and drainage systems to manage soil and water; and diversified cropping systems, including perennial crop integration, to restore fertility, increase yields and biologically control pests and disease (Altieri 1987, Pretty 1995, Gliessman 2006). While global food security imperatives tend to dominate sustainable agriculture narratives, such technologies have not only proven to enhance ecosystem resilience by internalizing negative externalities for more sustainable output, but when implemented in home gardens and on small farms can aid in improving and stabilizing yields for direct access to a wide range of culturally appropriate foods that can boost the nutritional health and improve the livelihood security of financially-poor households (Altieri 1999, Kremen and Miles 2012, Pretty et al 2006, Altieri et al 2012, Johns and Sthapit 2004, Masset et al 2011, Heywood 2013).

In the process of regenerating natural capital, SA practices enable local knowledge production and reflexive capabilities through experimentation and collaborative problem solving that begins at the farm site in order to develop relevant skills for successfully managing local agroenvironments. Participatory research and extension (PRE) can be contrasted with traditional top-down R&D approaches that are technically narrow and short in scope, and which tend to rely on less flexible experimental designs, such as autoconfigured cropping patterns and idealized plot sites without consideration for the diverse and more ecologically-challenging agrolandscapes of poor farmers and their long term strategies for dealing with change (Chambers 1992, Pretty 1995, Thompson et al 2007). Pretty (1995) explains that the process of strengthening local capabilities through non-passive participatory approaches is an essential component to SA processes as it drives the substitution of economically and environmentally costly inputs for human and social capital development upon which both agroecosystems and sustainable rural livelihoods depend[2]. The outcome of this process, therefore, is not only understood in technical terms of improved natural resource management and the protection of public goods, but is also valued as a mode to sustaining direct and indirect food access while strengthening participatory development and adaptive capacity (Chambers 1992, Thrupp 2000, Pretty et al 2003, Thompson et al 2007, IAASTD 2009).

Because institutional and organizational structures at different scales influence the availability of and access to SA technologies, coordinated policies that secure long-term access and utilization of SA innovations are critical to driving such transitions. This typically

[2] It should be noted the defining dimensions of SA closely resemble what Stephen R. Gliessman's (2006) describes as *Agroecology*, or the study of ecological processes for managing agricultural production, where external inputs and adverse ecological and social impacts are minimized.

necessitates collaborative participation between local farmer organizations (FOs), non-government organizations (NGOs), the private-sector more generally, as well as strategic state (macro-level and sectoral) interventions in order to "scale up" successful strategies (Pretty 1995, Poulton et al 2009, Altieri and Nicholls 2008). The correct policy mix, however, remains both time and place specific. The indispensable agency of external institutions nonetheless reveals the importance of, first, the need to internally develop the human, political, and financial resources to drive SA transitions; and second, reformulating agricultural interventions so that the ecological and social components of development are fully recognized (Conway and Barbier 1988, Pretty 1995, Scherr 2000, Kuyvenhoven 2004, Lee 2005, Thompson et al 2007, Altieri and Nicholls 2008). Without reducing the role of local actors in driving sustainable agricultural intensification (SAI), it has become widely recognized that dramatic increases in international investments for small-farmer oriented research and development (R&D) are now critical for bringing about sustainable transitions in agriculture[3] (WB 2008, IAASTD 2009, UN 2010, deSchutter 2010, HLPE 2013, FAO 2012).

2.2 Subsistence Food Producers

Who are they?

Homestead garden and small-farm food production systems operate within different agroecological zones on a worldwide scale. According to Vernon Heywood (2013), it is

[3] Between 1980 and 2007, public investments in agriculture have declined from 11.1 to 6.5 percent in East Asia and the Pacific, 6.6 to 4.9 percent in South Asia and from 6.9 to 1.9 percent in Latin America and the Caribbean (FAO 2012: 28).

estimated that subsistence farming systems make up 60 percent of the world's agriculture[4]. In tropical and subtropical regions, 1 billion people rely on home gardens and subsistence farming to procure food for household consumption and the market, providing up to 80 percent of the local food supply in developing countries through diversified cropping systems on 1-10 ha of land (Heywood 2013, FAO 2012). The forest environment within which subsistence practices are carried out not only help to provide critical ecosystem services that sustain local food production (Zhang et al 2007), but they also directly produce a variety of food, timber, and non-timer resources, acting as a social safety net and a source of income for over 1.6 billion people in the developing world[5] (Pimentel et al 1997, Arnold et al. 2011, Vedeld et al 2007). With economic inequity increasing globally, ensuring sustainability in forest-dependent livelihoods is more critical than ever (Arnold et al 2011). In order to gain effective insight into the ways local food systems can be sustainably enhanced, it is necessary to first gain a deeper understanding of who subsistence farmers are and how household food production practices have been situated in respect to other livelihood activities.

The term "subsistence," has been used to describe one's minimum resource needs to sustain life as well as a means of acquiring one's minimum food needs. This has created some confusion over the nature of those who produce food for subsistence as opposed to subsistence living*; subsistence production* is the production of food and other resources for household use with a degree of surplus for the market. While in pure form such activities exist within a self-contained and self-sufficient unit, subsistence production can often be

[4] This estimate is based on the size of production units.
[5] A meta-analysis of 51 case studies reveals that forest environmental income accounts for on average 22 percent of total rural livelihood income, with a median value of USD $346.00 per year for different socio-economic groups in forested areas. While environmental income varied widely by household, it nevertheless had an equalizing effect on local income distribution (see Vedeld et al 2007).

found on a spectrum within which one's level of food subsistence varies alongside one's accompanying levels of commercialization, where "semi-subsistence" and "semi-commercial" households exist at a midpoint between the two ends respectively (Wharton 1969: 13). Subsistence food producers are often, though not always accurately, associated with the term "peasant," which connotes conditions of social inequity produced by the integration of previously autonomous productive units into the market by historical processes of power and subjugation (Netting 1993). Though many who produce for subsistence may fall into the category of living under minimal material conditions, Ferdynand Zweig (1948) notes that it is often "easier to speak of poverty than to define it" (in Wharton 1969: 13).

Subsistence producers can be divided into two general types: the intensive and non-intensive agriculturalist. *Intensive farming* can be understood most broadly as a form of agriculture that provides high returns to land area by either relying heavily on non-renewable external inputs with high energy inefficiency per unit of output, or minimizing dependency on non-renewable external inputs for greater returns per input of energy. The former produces higher negative ecological externalities, including non-point-source pollution and reductions in biodiversity within and outside the agroecosystem, relative to the latter (Cassman 1999, Gliessman 2006). Those households who cultivate diversified low external-input permanent fields using site-specific biological and mechanical technologies under secure access to resources, manipulating soil and water resources to achieve higher and more stable production, can be typified as ecologically-intensified farming households (Netting 1993). Robert Netting (1993) typifies such farmers as *smallholders,* who, even amid engaging in off-farm work, produce with high ecological efficiency near the home with limited land resources to secure high yields per unit area (Netting 1993).

Shifting cultivation practices, on the other hand, are typically less intensive, characterized by labor and capital-saving extensive practices where primary and secondary vegetation is often burned to mobilize nutrient uptake and later fallowed for a number of years to control weeds and restore fertility before replanting (Gliessman 2006). Such farming practices existed since the Neolithic period (13,000–3,000 BC) in Asia, Africa, and Latin America, and remain an important livelihood strategy for anywhere between 37 million to 1 billion people, mostly located in the tropics (Thrupp et al 1997). Whereas limited land availability and high-demand markets influence land intensification, shifting cultivation is traditionally practiced in areas of high land to population ratios where abundant land resources are locally accessible (Netting 1993). Shifting cultivation systems maintain the highest output to energy input ratios. They also have low negative externalities when sophisticated use of fire and the incorporation of long 5–15 year fallows between short 1-4 year cropping periods are efficient in managing weeds, pests, and soil fertility (Gliessman 2006, Montagnini and Mendelsohn 1997). Such integral swidden practices using traditional ecological knowledge, historically considered "backwards" and in need of eradication (FAO 1957), are today valued as a natural form of forest disturbance that can maintain and improve ecosystem function and biodiversity without leading to permanent land conversion (Conklin 1957, Berkes et al 1995, Thrupp et al 1997, Garrity 2007, Padoch and Pinedo-Vasquez 2010).

However, with continued population, cultural and economic change, in addition to high levels of land concentration in Latin America, shifting cultivation associated with shortened fallows and longer cropping periods, the introduction of inappropriate crops, overgrazing and high off-farm resource extraction have contributed to fertility decline,

erosion and weed infestation that pose major problems to ecosystem maintenance and food security (Gliessman 2006, Stonich 1995, Schwartz 1995). However economically and socially efficient in the short-term, such incipient swidden practices can lead to higher dependency on chemical inputs (Steinberg 1998), while acting as an additional driver of deforestation and biodiversity loss (Conklin 1957, Myers 1994, Sanchez et al 2005); though not at comparable disturbance rates of large-scale monocrop and livestock expansion in Latin America (FAO 2000).

It should be noted, however, that long-colonized forest users and new forest colonists practicing what Brown and Shreckenberg (1998) call "shifted cultivation" have also been shown to adapt to local environmental constraints in innovative ways amid external pressures to unsustainably exploit local resources (Browder 1994, Yanggen and Reardon 2001). Others directly question the linearity of "breakdown scenarios" in less intensified systems that not only reveal questionable correlations between shortened fallow periods and lower yields (Mertz 2002), but also overshadow larger socio-ecological complexities (Brown and Schreckenberg 1998, Geist and Lambin 2002, Van Vliet et al 2012), including political-ecological processes (Grossman 1997, Steinberg 1998). Today, efforts to end the practice, as it is perceived to be *the* principle cause of tropical resource degradation (Myers 1994, Sanchez et al 2005), can be contrasted with efforts to sustainably enhance such systems in practical and relevant ways to farmers as a mode to maintaining diversity in livelihoods and landscapes (Kleinman et al 1995, Montagnini and Mendelsohn 1997, Padoch and Pinedo-Vasquez 2010).

Common to both intensive and non-intensive producers is the tendency to cultivate relatively small land parcels at any one time with limited out-of-home labor. Irrigation,

digging sticks, hoes, plows, and combine harvesters have been used in both systems and, while agroecological knowledge is rich among intensified smallholders, traditional knowledge systems under swidden practices also persist to varying degrees (Netting 1993, Thrupp et al 1997). Furthermore, it can be the case that a subsistence farmer engages in a combination of both permanent and shifting cultivation, based on the cultural and economic context of the local environment (Brown and Schreckenberg 1998). Thus, the nature of household food production, influenced by socio-economic conditions, the local ecology, and the political-economies within which they operate vary widely and cannot be broadly characterized (Netting 1993, Thrupp et al 1997).

Home garden systems

As an extension of household food systems, home gardens can be intensively cultivated or produced in less intensive ways depending on variable pressures and opportunities. According to Stephen Gliessman (2006), a *homestead garden* can be described as an integrated ecosystem of humans, plants, animals, soils and water located near the homestead. Tropical home gardens reflect great complexity and diversity where trees play a critical role in the ecology and management of the system, resulting in a wide range of low-cost plant and animal derived proteins, carbohydrates, vitamins and minerals for household consumption, in addition to providing an alternate source of income, fuelwood and fodder (Ninez 1986, Chambers 1990, Gliessman 2006).

Mesoamerican horticultural practices are rooted in ancient Mayan agroforestry systems that combine local annual and perennial crops within multiple strata with local

livestock. The system today is commonly managed by women using crop residues and ash deposition to improve nutrient cycling and provide households with a basic food and income source (Montagnini 2006, Howard 2006). They are also valued for their spiritual, medicinal, and aesthetic properties, as well as the social regard given to those who manage them (Howard 2006, Marquez and Schwartz 2008). Though such systems are most resilient when they are dynamic and flexible, homestead garden complexity and productivity can fluctuate with shifts in labor and resource allocation, as well as from changing cultural practices, much like wider subsistence systems (Gliessman 2006, Montagnini 2006).

Johns and Sthampit (2004) argue that the globalization of the western diet based on high-input and high-yield refined carbohydrates (wheat, rice, and sugar) and greater reliance on street foods has provided cheap calories to financially strapped households, but has also reduced dietary diversity in many circumstances. Changes in cropping patterns and reduced contributions of local food crops to the diet have resulted in micronutrient deficiencies and higher rates of chronic noncommunicable disease (Johns and Sthampit 2004). Given the value of local crops, wild plants and animals within home gardens and surrounding forests to household subsistence, sustainable home gardening continues to be forwarded as a multifunctional means to supporting adequate nutrition, income generation, as well as *in situ* biodiversity conservation (Ninez 1987, Lok 1998, Johns and Sthampit 2004, Masset et al 2011, Montagnini 2006, Pulido et al 2008, Heywood 2013).

The diversity within livelihood diversification

Most small farming households in developing countries today employ several

strategies to make a living in addition to the production of crops and livestock. Off-farm income is estimated to reflect roughly 50 percent of rural income in Latin America and Asia, and 35 percent in Africa, with the landless and near landless depending most heavily on off-farm income sources (Haggblade et al 2010). Ellis (1998) argues that a necessarily diverse set of rural livelihood strategies help households meet both immediate and long-term cash and resource needs, including on-farm investment needs. Based on one's combination of capabilities and assets, motivations and constraints, a household organizes how time is allocated and how such activities are carried out and by whom. Multiple livelihood strategies can include seasonal migration and longer-term employment in wage labor, the use of in-country and out-country remittances, utilization of forest resources and engagement in informal enterprises (Conway and Barbier 1988, Ellis 1999). Livelihood diversification to manage uncertainty, and diversification to maximize consumption and investment that strengthen capital assets, both lead to strategic diversification on and off the farm based on subjective evaluations of risk and potential returns over the long run[6] (Ellis 2000).

Given that food access is subject to fluctuations in both economic (e.g. wage variability and food prices), ecological (e.g. soil fertility and climate variability), and social (e.g. resource access and political interference) terms, agricultural households tend to be cautious in their investment choices (Walker and Jodah 1986, Ellis 1998, Maxwell and Wiebe 1999, Thompson et al 2007). As such, on-farm crop diversification functions as an *ex-ante* livelihood strategy for offsetting disturbances in food and/or income flows generated on and off the farm (Walker and Jodah 1986). Intercropping, spatial scattering, and the customization of production to different microenvironments is central to this practice and

[6] Risk in this regard can be understood not only as economic-based risk, but also uncertainties related to natural and social assets.

allows access to a wide array of grains, vegetables, root crops, and fruits throughout the year, thereby reducing risk of total crop failure (Walker and Jodha1986, Chambers 1990). Walker and Jodah (1986) point out that such a strategy, often typified as producing lower net-returns, can actually result in higher average returns over the long run; suggesting that what often appears as a trade-off between risk aversion and higher returns on investment is often times the most efficient and profitable strategy for such households.

While livelihood diversification may be seen as an inherent feature within rural household systems, Dorward et al (2003) nonetheless argue that SRL theoretical framings too often downplay the role of markets in driving pathways out of poverty. Through their ideological critique of both market fundamentalism and market skepticism, they stress that rural livelihoods are not static, but remain inextricably linked to technical, institutional, and market arrangements, that, when functioning optimally, play a pivotal role in forwarding livelihood sustainability. Here, the role of coordinated markets and small farmer led agricultural growth is emphasized as an engine of sustained and broad-based development that allow rural households to step up economically within the sector, as well as out into higher-return non-farm activities. As such, agriculture plays a dynamic role within the rural landscape by satisfying household needs within different types of diversified livelihoods, as well as driving greater economic security in farm and off-farm settings.

Maripa Mendola (2007) further argues, however, that farm investment decisions do not seamlessly follow institutional models of profit maximization. Mendola explains that neoclassical theories, in assuming consumption- and production-maximizing behavior among farming households, where efficiency is the result of perfect market competition, fail to fully

accommodate for risk and the influence of social norms in decision-making processes. Even after accounting for limited information systems and other market failures in rural areas that prevent first-best transactions, agricultural households in developing countries are shown to favor both investments into higher-value returns, while others continue to maintain low risk alternatives. Differences in resource constraints, and access to market/non-market insurance mechanisms and other institutional arrangements remain important determining factors. However, the socio-cultural context in which household production takes place is also a critical underlying driver that is less understood by economists. As a result, resource allocation decisions by low-income, and even higher income households, tend to reflect a "bounded rationality" beyond individual decision making power; where livelihood diversification into a range of lower-return activities may be preferred over investment into a single profit-maximizing venture.

Situating rural livelihood systems within rural development and agricultural growth initiatives, therefore, vary across theoretical frameworks. Modernist narratives historically emphasized transforming small farmers into state managed producer operations or competitive enterprises that maximize efficiency and production through comparative advantage; allowing for the exit of less competitive farmers from the sector (Netting 1993, Thomson and Scoones 2009, HLPE 2013). With the resurrected value of agricultural investment for pro-poor growth now moving back to the forefront of the development agenda in the midst of widespread market failures, global food price surges, and economic instability in net food-importing countries, small farmers have become re-embedded in discourses ranging from greater domestic protection to drive non-farm rural development and future economies of scale (Hazell and Diao 2005, Dorward et al 2004a); to honing in an "ever-green

revolution" that can reduce production costs while meeting future food demand (Swaminathan 2001); to securing national *food sovereignty* through small-scale agroecological farming as a mode to participatory development and sustainable local and world food security (Rosset 2006, Altieri and Nicholls 2008, Altieri and Toledo 2011, Holt-Giménez and Altieri 2013).

Notwithstanding the importance of agricultural development to small farmers, rural livelihoods literature highlights that any attempt to understand "productivity constraints" within local farming systems should take care not to reduce the issue to a narrow economic problem alone. Agricultural livelihoods should be explored within a wider rural environmental context that takes into consideration the relative value of off-farm employment, social norms and risk reduction priorities, as well as resource management arrangements that dynamically shape different livelihood pathways (Thrupp 1998, Ellis 2000, Mendola 2007, Thompson and Scoones 2009). Thomson and Scoones (2009) make the case that an interdisciplinary investigative approach to sustainable rural development is needed. Capturing the heterogeneity within local farming communities is seen as the first step into a more nuanced analysis of the opportunities and constraints to enhancing local food and livelihood security, while critically informing larger paradigmatic narratives focused on future socio-technical trajectories in agriculture.

Some driving factors of sustainable agricultural development

Whereas ecologically-intensified farmers can represent high adaptive capacity to withstand changes in ecological and economic conditions (Netting 1993, Pretty 1995), non-

ecologically intensive permanent agriculture, representing the conventional capital-intensive monocrop farming practices of the first Green Revolution, and extensive agriculture with high negative externalities, can adversely impact ecosystem function within and off the farm (Cassman 1999, Tilman et al 2002, Gliessman 2006). Since the over-exploitation of natural resources at the household level is often a short-term means of earning a livelihood and securing food, land degradation can be consciously or unconsciously overlooked depending on the importance of land-based activities relative to other strategies, one's investment capacity, and the degree of local ecological knowledge (Frankenberger and Goldstein 1990, Scherr 2000, Wiebe 2003). The relationship between poverty and the environment is also linked to larger natural and institutional processes that play a role in how households respond to resource depletion (Carswell 1997, Forsyth et al 1998, Scherr 2000). As such, multiple driving factors have been identified for driving SAI and wider NRM.

Access to relevant information for participatory knowledge production- According to Toledo and Barrera-Bassols (2008), 50 percent of small farmers in developing countries do not use resource conserving agricultural methods. The role of participatory research and extension in generating awareness, shaping attitudes, and ensuring sustained utilization of SA technologies has been argued as a key component to successful SA interventions. While participatory approaches can vary in their degree of effectiveness and representation (Cooke and Kothari 2001), building resilience in agroecosystems remains less a factor of the technology utilized per se, and more an issue of strengthening the human and social capital necessary for collaborative investigation and evaluation (Pretty 1995). Therefore, FOs, national research and extension services, and NGOs must go beyond delivering pre-packaged

consultation and technology by creating space for knowledge exchange and the negotiation of information that enable social learning and incremental adoption and adaptation (Conway and Barbier 1988, Chambers 1992, Thrupp 2000, Pretty 1995, Thompson et al 2007, Altieri and Nichols 2012).

Secure land rights- Resource tenure, as a system of rights and institutions that govern access to natural resources, must be well defined to ensure stability in private and communal land management systems (Maxwell and Wiebe 1999). Secure resource rights are not contingent upon private ownership, but tenure arrangements must provide formalized long-term security to households so that returns to sustainable resource management are captured locally. Key determinants include formal land titling and customary land arrangements, while insecure usufruct rights (e.g. short-term leases) or land rentals discourage sustainable NRM (Maxwell and Wiebe 1999, Wiebe 2003).

Well-performing markets- Even when farmers are concerned about resource degradation and local technology is accessible, rural households may refrain from sustainably intensifying production if the payoffs of longer-term returns are risky or unattractive (Mendola 2007). While the role of markets in helping drive SAI is undisputed, controversy surrounds how markets should be used to promote sustainable agricultural development and under what conditions and pretexts market interventions are legitimized. *Free market-oriented* approaches, forwarded by transnational trade, financial and food security institutions, including the WTO, World Bank and FAO, emphasize public investments that improve infrastructure, research and extension, and access to financial services. Generating adequate access to input and output services, therefore, is largely dependent on the

coordination of effective FOs (Schanbacher 2010). While many of these measures rely on strategic public interventions, wider *interventionist* approaches argue, on the other hand, that effective state coordination of input and output markets is necessary in underdeveloped rural economies, not only to avoid market failures, but also to drive pro-poor growth and national food self-sufficiency through the production of import-competing staple foods (Kydd and Dorward 2003, 2004, Rosset 2006, Schanbacher 2010). It is important to note that interventionist approaches can range from medium-term institutional coordination to fill gaps in thin markets, to guaranteed markets for specific groups over longer periods of time.

Payment Mechanisms- Payments for ecosystem services (PES) are a market-based public and/or private approach to securing sustainable NRM. While oriented at land users of all sizes, it has also come to be seen as a substitute for state-sponsored productive support to small farmers. PES schemes also emphasize that private criteria is insufficient for driving NRM, as natural resources and ecosystem services are wider public goods that necessitate proper compensation for optimal conservation (Milder et al 2010, Lee 2005). Market-based financial compensation schemes have raised the value of cost-sharing arrangements and targeted payments for longer-term PES to small farmers. Cost-sharing arrangements include short-term credit and payment schemes designed to generate interest in unfamiliar technologies and support initial shifts in practices (Wiebe 2003, Scherr 2000). Longer-term PESs oriented at small-scale land users have been promoted as a complementary "asset building" strategy, with potentially lower costs than traditional PES approaches (Milder et al 2010). Given resource rights are secure and payment incentives are large enough to result in net-benefits to a household, financial compensation to investment-poor land users can also

contribute to livelihood sustainability, food security, and wider conservation objectives (van Noordwijk et al 2007, Milder et al 2010).

In local settings where household incomes are strained and variable, property rights not clearly defined, SA technologies inaccessible and inappropriate, and market conditions thin and unstable, investments aimed at improving household food and livelihood security may be undermined or simply go unrealized. While the aforementioned driving factors are not determinate as no single policy unambiguously enhances NRM and sustainable livelihoods[7], driving SA development goes beyond traditional unidimensional approaches and necessarily brings into question current governance processes shaping policies in food and agriculture. Because development paradigms inherent in operational framings shape institutional arrangements and policy pathways, Thomson and Scoones (2009) stress that they must be made more explicit in order to unlock the biases and constraints that limit engagement with complexity and uncertainty inherent in food systems (Thompson and Scoones 2009).

2.3 Food and Agricultural Policy in Belize: Past and Present

[7] SA technologies are a necessary, but not sufficient in securing rural livelihood sustainability and NRM. For example, infrastructure development can lead to increased exploitation of forest resources; reduced tillage practices can encourage greater use of herbicide; agricultural intensification can demand greater workloads from household members and encourage land concentration; stabilized markets can induce agricultural expansion; improved local organizational capacity can attract political conflict (Pretty et al 2003, Kremen and Miles 2012, Kuyvenhoven 2004, Lee 2005).

Belize is made up of three distinct geographical regions that include the northern low-lying plains of limestone, the southern Mayan Mountain range consisting of slates and granites, and the barrier reef system of the Caribbean Sea (Barry 1990). After discounting the steep sloping terrain of the Mayan Mountains and upland karst topography, 36 percent of the total land area is considered suitable for agriculture, with roughly half currently allocated to livestock production and the cultivation of traditional sugar-banana-citrus export crops. The other half is characterized by poor drainage capacity and soil management problems due to vulnerability to compaction and shallow depth to bedrock[8] (MAF 2003a). A third of all land under agriculture, however, is on soils considered marginal or unsuitable for cultivation (Meerman and Cherrington 2005). The Belize Farm Registry has estimated a total of 9,697 farms in the country (Belize Farm Registry 2002). However, preliminary results from the 2011 Agricultural Census indicate a substantially higher number of 19,236 total farms (Tate 2013). While updated information on farm size is not yet available, it is estimated that 74 percent of farmers cultivate on less than 50 acres of land, 57 percent on less than 20 acres, and 24 percent producing on less than 5 acres (Belize Farm Registry 2002).

Agricultural practices vary widely by region. The traditional long-fallow shifting cultivation system in Mesoamerica, known as *milpa* cultivation, is based on the cultivation of corn, beans, and squash cropped alongside a wide variety of annuals and perennials to produce both food and non-food resources for the household (Toledo and Barrera-Bassols 2008). In Belize, over half of all farmers continue to practice some form of shifting cultivation. Swidden systems are predominant among Maya communities in the southern

[8] The International Development Bank suggests that only 9.7 percent of arable land is utilized for agricultural given the amount of idle land registered as a farm (ICD 2010).

districts, by agricultural laborers in the citrus and banana industry, and by mestizo farmers in the west and north (MAF 2003a, Bernsten and Herdt 1977). The majority of such farmers live under the poverty line and account for 60 percent of the country's corn and rice producers. Today, 25 percent of all corn output in the country is produced under shifting cultivation (MAF 2003a, MAF 2008).

Traditional Mennonite farmers, who migrated to Belize as autonomous communities as early as 1958, practiced shifting agriculture as an initial form of adaptation before beginning more intensified integrative farming completely independent of fossil fuels (Roessingh and Schoonderwoerd 2005, Holder 2009). With cultural transformations driven largely by religious differentiation in the Cayo district, large scale mechanized producers cultivating hundreds of acres per farmer to produce monocrops of grains using high levels of external non-renewable inputs represent Belize's modern grain agribusiness sector, located in the Mennonite town of Spanish Lookout (Roessingh and Schoonderwoerd 2005). Despite the country having the least population density in Central America, at 14.5 people per km^2, the country's deforestation rate has been estimated to be as high as 2.3 percent, or twice that of Central America, though more reliable estimates place annual rates closer to 0.6 percent (Cherrington et al 2010, FAO and GOB 2011a). Proximate causes involve expansion in permanent agriculture, including livestock, in addition to increased pressure from shifting cultivation (Chomitz and Gray 1996).

A brief history of agricultural development in Belize

Unlike the rest of Central America, Belize's colonial economy was founded on timber extraction, not plantation agriculture. Since the very beginning as a de-facto British colony in the seventeenth century, Spain granted Great Britain logging rights to the territory under the condition that no other form of economic activity be developed. Rising demand for dyewoods and, later, mahogany in Europe drove the illegal expansion of the timber trade using African and Caribbean-born slaves. The official granting of extended timber rights by Spain under the Convention of London in 1786 came at the cost of abdicating all forms of local political and legislative activity that attempted to organize land claims in the territory. The convention also reaffirmed the illegality of alternative forms of productive activities by officially prohibiting the development of agriculture beyond small subsistence plots that lowered the costs of slave labor. This led to a narrow pattern of capital accumulation that kept both slave and non-slave workers locked into unfavorable labor relations with the territory's timber elites and dependent on imports from Europe and adjacent Spanish colonies (Grant 1976, Bolland 1977). While some escaped the timber trade to become autonomous farmers, and new immigrants later settled the north and south as short-fallow and permanent agriculturalists, land concentration and an economic system built on social exclusion and debt peonage would effectively undermine the development of a large independent peasantry (Bolland 1977, Bolland and Shoman 1977).

By the latter half of the nineteenth century, with the waning of Spanish sovereignty in the hemisphere and the rise of U.S. economic hegemony, resource depletion and plummeting prices in timber led to the formation of transnational joint stock companies that consolidated

land resources for investments in large-scale commercial agriculture. The largest companies, particularly the Belize Estate and Produce Company and the United Fruit Company, played central roles in shaping land and labor policies in the Legislative Assembly, with the effect of usurping autonomous villages of their land rights and limiting competition in agriculture (Bolland and Shoman 1977, Moberg 1997). The use of Maya, Mestizo, and Garifuna peoples as seasonal farm workers through tenancy contracts, advance payment systems, and land taxes, along with the importation of Chinese and East Indian indentured laborers, were understood as necessary preconditions to ensuring an sufficient labor supply for the industrial expansion of sugar, citrus, and banana exports[9]. These new institutional arrangements led to the creation of special type of farming culture amongst rural people, what Cedric Grant (1967) calls Belize's "agro-proletariat," or part-time farmer, where rural households supplement their low wages with local agriculture to meet livelihood needs (231). In this way, changes in the global comparative advantage of timber production effectively drove the transfer of political and economic power from autonomous rural villages growing corn, beans, rice, sugar, and tobacco for the domestic and international market to large transnational farms favored by the colonial state (Grant, 1976, Bolland and Shoman 1977).

At the same time that small subsistence farmers were integrated as cheap labor into the colonial economy, colonial authorities provided incentives to white immigrants to lead the expansion of mechanized agriculture at subsidized rates. Unlike the Maya, Mestizo, and Garifuna farmers who had to pay up to 25 times more for agricultural land, white immigrants, rich or poor, were considered independent, dependable, and development-oriented and were thus given land and access to machinery at heavily discounted prices

[9] This process reflects what, in Latin America, has been termed the *latifundia* system (Iyo et al 2003).

(Bolland 1977, Iyo et al 2003). While both mechanized and non-mechanized systems included some subsistence production, the larger and more intensified the estate became, the smaller the area dedicated to subsistence crops (Bolland 2003, Iyo et al 2003). By 1930 six percent of all landowners controlled 97 percent of freehold land, where sharp fluctuations in the price of agricultural exports left land resources both idle and inaccessible to small farmers and landless wage workers. By 1971, 90 percent of these land holdings would be transferred to foreign speculators based predominantly in the United States (Bolland and Shoman 1977).

Since 1964, the original Peoples United Party (PUP) made efforts to redistribute land to every Belizean in an attempt to encourage greater agricultural production that promoted wider economic development (Bolland 2003). When Belize achieved full independence in 1981, land reform and agricultural development remained a national priority, along with education, healthcare, and housing. The extension of land leases through the location ticket system became the central arrangement to encourage land development, where agricultural subsidies, extension services and food price stabilization policies promoted both export orientation to preferential markets as well as national food self-sufficiency by reducing risk to farmers under an import substitution model of development (Robinson and Furley 1983, Moberg 1991). The Belize Marketing Board maintained storage facilities and grain purchasing centers in all districts through the 1970's to encourage production in staple foods and to redistribute foodstuff to prevent glutted local markets that, between 1978 and 1983, doubled staple crop production and moved the country from a net-food importer to a net-food exporter in grains (Moberg 1991).

By the 1980's, global recession and deterioration in Belize's terms of trade substantially weakened the economy, leading to structural adjustment with the IMF in 1984[10] (Alvarez 1988). In the process of restructuring the economy away from an Import Substitution Industrialization (ISI) model towards an open export-led growth model, fiscal austerity measures led to the closing of half of the Marketing Board's purchasing centers and the halting of all corn purchases. Reductions in producer price floors not only discouraged agricultural intensification among farmers, but also led to a contraction in staple crop production and a sharp reduction in national food self-sufficiency (Moberg 1991). During the same period, efforts at land redistribution also slowed dramatically, leaving 3 percent of landowners with 90 percent of all freehold land by 1986 (Iyo et al 2003). Mark Moberg (1992) argues that, while inherent structural features in developing countries contribute to deteriorating terms of trade, inflation, and increased deficits, the IMF's emphasis on market deregulation and the privatization of state assets have reinforced prevailing patterns of "disarticulated accumulation" by suppressing purchasing power and encouraging land concentration for large-scale industrial growth[11]. Within this development context, subsistence-based agriculture has continued to subsidize low agribusiness wages and wages remain suppressed by the importation of cheap labor and low consumer food prices in both domestic and international markets (Moberg 1992, Moberg 1997, Sutherland 1998).

[10] Balance of trade deficits caused by oil price increases and declining terms of trade caused Belize to incur large foreign debts by the late 1970's. With economic stagnation in world trade between 1980 and 1982, the demand for primary goods dropped dramatically, constraining foreign exchange earnings and revenues. Long term real world market declines in sugar prices, coupled with restricted credit policies and rising global interest rates, increased the country's debt burden, forcing Belize, like much of the developing world, into emergency loan negotiations with the IMF (Alvarez 1988, Moberg 1992).

[11] Until the 1980's, increases in industrial productivity in metropolitan economies were coupled with rising real wages among workers to maintain demand for consumer goods. In narrow export-oriented economies, however, wages in industry have historically been reduced to a cost of production, not a means of sustaining output (de Janvry 1981 in Moberg 1992)

The state of food and agricultural policy

Today, the agricultural sector, including agriculture, forestry and fisheries, constitutes only 14 percent of GDP[12], yet still accounts for three quarters of the country's foreign exchange earnings and directly employs one-fifth of the labor force. This includes half of the rural population and half of all poor individuals, while indirectly employing the majority of workers in the country's manufacturing sector[13] (FAO and GOB 2011a, NHDAC 2010). At the same time, the value of personal remittances received continues to grow, representing 5.6 percent of total GDP in 2008. This positions Belize as one of the top 30 remittance sending countries in the world (WB 2013). The current mission statement of the Ministry of Agriculture and Fisheries (2012) reads:

To continue as the economic pillar of Belize, ensuring food security, generating income and foreign exchange, creating employment, and conserving natural resources, in order to grow the economy, reduce poverty and empower the local population for sustainable development.

Belize, like many developing countries today, is in the process of externally re-orienting the domestic economy to global market forces as a means of encouraging greater foreign investment and economic growth. As a result, structural reforms are aimed not only at cutting government spending, but also at phasing out non-tariff and tariff barriers that protect labor-intensive industries in order to remain compliant with the WTO and its

[12] The decline in agriculture's contribution to GDP results from eroded preferential markets and the discovery of oil in 2006 (WTO 2010). Agriculture has held a roughly constant share of GDP between 1970 and 2007, when measured in constant prices. However, in terms of *current* prices, agriculture to total GDP has diminished by half within the same time period, with almost all of the drop occurring after 1990 as a result of deteriorated terms of trade (IDB 2010).

[13] According to Deep Ford and Rawlings (2007), Belize's agricultural employment to total employment ratio was 30.1, the second largest proportion in the Caribbean after Haiti.

corresponding Agreement on Agriculture[14] (AoA) (MAF 2003a, Singh et al. 2005). As such, the National Food and Agricultural Policy for 2002 to 2020 outlined by the government of Belize (GoB) has aimed to transform the agricultural sector into a globally competitive industry under the pretext that each producer be considered "a businessperson capable of making rational economic decisions that allows them to increase their income, be financially independent and to sustain their activities through the efficient use of resources" (MAF 2003a: 6). To date, the GoB has carried out this mission by focusing on export crop diversification in the face of deteriorating preferential trade and downward price trends in traditional export crops. Local entrepreneurial capital is expected to be built through the development of well-functioning FOs that can allow individual producers greater access to financial capital. Such actors are now considered pivotal for achieving improvements in quality standards for contract farming arrangements in an increasingly competitive agri-food market (MAF 2008, FAO and GoB 2011a).

Belize's agricultural sector still enjoys internal market protections against import-competing products where markets are strategically opened using non-automatic import-licenses to supplement fluctuations in domestic food supplies. Despite the elimination of price supports to grain farmers[15], the system has allowed for a rebound in national self-

[14] In reforming the Import Substitution Industrialization (ISI) model that prevailed in Latin America during the 1970's, structural adjustments in mid-1980's was marked by wage freezes, tax and utility rate increases, the substitution of import restrictions with moderate tariffs on commodities, and reductions in social spending, including the elimination of farmer subsidies and price stabilization policies, in an attempt to attract foreign direct investment (FDI). Free Trade Agreements (FTA) and current commitments under the WTO aim to further reduce and eliminate current tariff and non-tariff barriers to global trade (Alvarez 1988, Moberg 1992, WTO 2010).

[15] The exception here is rice production in the Toledo district, the poorest and most agriculturally-dependent district in the country, where the state Marketing Board continues to purchases rice from small farmers based on a guaranteed floor price, which is then processed and distributed based on a maximum consumer ceiling price (MAF 2003a).

sufficiency in grains, along with greater outputs of beef, poultry, eggs and increasingly fruit and vegetables, thereby reducing the need for foreign exchange spending on imports (see Appendix B) (MAF 2003a, MAF 2008). Under provisional market protection, small farmer development projects have also been initiated in some villages to improve the competitive capacity of commercial agriculturalists, especially in vegetable production (MAF 2008). However, greater compliance with FTA obligations under the AoA further threaten political support for even current levels of protection and small farmer assistance, as alignment with global markets takes precedence[16]. The Director of Extension, who is responsible for helping to coordinate the activities of the country's 27 extension officers, reflects this ideological shift when stating:

Farmers today have to have a business mindset […] Subsistence and slash and burn farmers need to become more entrepreneurial and focused on non-traditional crops. They cannot farm only when they want. They have to be permanent […] If you are a small player, you will get a small part[17].

Broader rural development initiatives reflect similar market-oriented strategies. Half of the projects supported by the Belize Rural Development Project (BRDP) are related to agriculture. Projects specifically target households living under the poverty line (calculated as those making less than 680BZ per year) with the aim of building entrepreneurial capital to participate in the free market. This is achieved by supporting local organizational capacity, providing marketing and small infrastructural support, in addition to micro loans. Households

[16] Addressing technical barriers to trade include notification requirements concerning import restrictions and licensing, and to the creation of any investment incentives in the domestic economy (WTO 2010).
[17] Robert Harrison, Director of Extension, Belmopan, personal communication, 31 October 2012. Note: "non-traditional" here means diversification out of the traditional citrus-sugar-banana export crop sector to become more commercialized in a diverse array of foods for the domestic and global market.

are expected to submit project proposals that prove profitable and self-sustaining, and require groups invest 25 percent of the total project cost in addition to any manual labor requirements as proof of project ownership. To date, administrative costs and time requirements for micro-level management, along with high levels of group insolvency, have undermined the efficacy of the project (NHDAC 2010).

The Belize Rural Area-based Development Strategy (BRADS), initiated by the GoB in December 2010, seeks to develop a more structured approach by streamlining rural development projects and decentralizing project planning to farmers for better coordination with industry sector objectives. Through public-private partnerships mediated by Area Development Groups, the GoB hopes to provide sufficient public services in rural areas for successful market integration that can "encourage stakeholders in rural areas to commit to promoting their own development and well-being" (FAO and GOB 2011a: 41). This new strategy, also aimed at building resilience to economic and ecological disasters, simultaneously plans to contain fiscal expenditures while strengthening public sector institutions, so that citizens can be capacitated to "embrace economic opportunities in the face of ongoing economic crisis" (GOB 2010: 8).

Despite multiple pathways to development, the Food and Agricultural Organization of the United Nation's (FAO) Country Programming Framework for Belize 2011-2015, also advocates strict market approaches for encouraging food security and agricultural growth in the country. Redirecting government investments into upgrading phyto-sanitary standards to become compliant with new WTO trade requirements is of special consequence. With the intention of achieving high levels of competitiveness among the country's small farmers, the FAO reinforces the GoB's call for greater investments in roads, storage and processing

infrastructure, land tenure security, cooperative development, greater access to credit and crop insurance, as well as the transfer of low cost and low input SA technologies (FAO and GOB 2011a).

Meanwhile, land tenure arrangements have not changed substantially in the country. Current land legislation is based on 19th Century statutes updated in 1992 through the National Lands Act (NLA). The NLA governs laws related to freehold and leasehold parcels, the latter being the distribution of former "Crown" lands to encourage the productive use of idle public goods[18]. Leaseholds are dependent on obtaining a recommendation by the area representative followed by land development that, once met, allows the lessee rights to purchase the land at below market value (Iyo et al 2003, GOB 2003). Meeting development standards is typically associated with extensive forest clearing for crop and livestock production (Steinberg 1988, Clark 2000). However, tenure insecurity remains widespread do to a lack of formal land registration (Iyo et al 2003). Moreover, under leaseholds the state still has the authority to retract contracts at any time if greater revenues can be generated through other ventures (GoB 2003). To compound the problem, intensifying land markets, government corruption, and political divisiveness at the village level are contributing to land conflict[19] (Sutherland 1998, Duffy 2000, Iyo et al 2003). Today, private ownership only makes up 32 percent of all farmland, with the remainder cultivated on rented, public or state reservation lands (WB 2009). As such, unofficial squatting is commonplace, especially in

[18] The British Crown concentrated unregistered lands to control timber resources and land use laws by indigenous people (Bolland and Shoman 1977).
[19] The corruption index for Belize declined from 4.5 in 2003 to 2.9 in 2008. A score of less than 5 out of 10 indicates serious corruption, while scoring less than 3 indicates rampant corruption (NHDAC 2010).

western Belize, while once-subsidized surveying costs have now been transferred from the government to the lessee[20] (Iyo et al 2003).

The strength of subsistence-oriented farmer services

Whereas all types of farmers, including subsistence and commercially oriented producers, face on-farm challenges to long-term sustainability (Kellman and Adams 1970, Arnason et al 1982, Arnason and Lambert 1982, Lambert and Arnason 1986), no formal policy direction by the FAO nor the GoB have been established in sector planning reports for ensuring that those farmers who remain subsistence-oriented are actively included in SA initiatives. With the exception of assisting the development of school gardening programs in specific areas and targeting small groups for improved subsistence capacity, the FAO in Belize has supported the interests of subsistence-oriented farmers more generally only in *ex-post* emergency situations in response to natural disasters and soaring food prices by funding seed and seedling production for local distribution (FAO and GOB 2011a). Despite such lessons, there remains no explicit policy strategy to sustainably enhance the production systems of the country's subsistence producers to ensure long-term stability in food output.

The National Food and Nutrition Security Commission (NFNSC) was established in 2001 to serve as an advisory board to the Cabinet in matters related to food and nutrition security. With the mandate of ensuring "food security and sovereignty through sustainable local production, supply, accessibility and use of safe, high quality, nutritious, diversified and culturally-acceptable foods for all Belizeans," the National Food and Nutrition Security

[20] Robert Harrison, Director of Extension, Belmopan, personal communication, 31 October 2012.

Policy for Belize stipulates, as one of its six central objectives, the aim to enhance diversified household food production as a mode to securing sustainable local food security (NFNSC 2010: 9). As such, the food and nutrition security framework addresses the need for improved access by subsistence-oriented producers to SA technologies to stabilize home garden and on-farm production. Supporting access to appropriate storage systems, to improve post-harvest management and better regulate fluctuations in consumer and producer prices, is acknowledged as a critical element to optimal self-sufficiency and income generation. It is not yet clear, however, how policy rhetoric has translated into strategic outreach to subsistence farmers beyond the market-based strategies of the MAF.

In an attempt to inquire further, the author conducted an informal semi-structured interview with the current NFNSC chair, Fernando Tzib, on October 29, 2012. In response to inquiring how the commission aims to ensure sustainable food security for the rural poor, who are today spread more evenly across the country[21], the chairman responded that "[rural households] below the poverty line are not [necessarily] at risk of food insecurity." The chairman explained that rural households have access to land for subsistence food production, which "is not counted [in official statistics][22]." In addition, securing greater access to SA technologies is considered a factor of more active farmer involvement in local trainings and workshops. That is, greater utilization of the extension services offered at district research stations. This reflects the Director of Extension's general view that

[21] Prior to the global economic recession beginning in 2007, rural poverty was disproportionally located in the Toledo district (NHDAC 2010).

[22] Two officials representing the Ministry of Human Development interviewed also expressed similar sentiments that household farmers in Belize, particularly those in the Toledo district, are not poor relative to urban households due to the subsistence resources and income generated from food production that are not captured in international agency surveys and thus do not deserve the degree of attention they receive to improve their livelihood conditions (France Wesby and Camari Usher, Ministry of Human Development, 15th November 2012).

government outreach today must necessarily be "demand-driven" in order to encourage a business mindset no longer dependent on "hand outs[23]". The chairman of the NFNSC ended by emphasizing that the World Food Programme (WFP) confirms Belize has sufficient *supplies* of food to meet domestic consumption needs, so that NFNSC priorities for agriculture can shift to mitigating the impacts of natural disasters on the most vulnerable farmers.

Based on these interviews, the ecological sustainability of subsistence food systems is not a priority for the NFNSC. Within a project-oriented framework, resilience building is seen only as a necessity for targeted households at greatest risk of natural disasters, despite ecosystem degradation and climate change posing new challenges to all subsistence producers in the country. For the rest, taking greater advantage of the extension services available at district offices is considered the individual responsibility of the farmer. Despite a growing rural population[24], human and financial resources further constrain the outreach capacity of the MAF. In 2008, institutional support to the agricultural sector stood at 1.8 percent of the national budget (NHDAC 2010). In 2010, the recurrent budget to the sector had fallen below 1.5 percent, increasing dependency on external donor support for achieving sustainable development goals (FAO and GOB 2011a, NHDAC 2010). In this context, remaining competitive through conventional means, or non-intensive due to a lack of access to appropriate technologies, may come at greater cost to the local environment and long-term food security in rural areas.

[23] Robert Harrison, Director of Extension, personal communication, October 31, 2012.
[24] According to the World Bank, the rural population as a percent of the total population has increased from 53.1 percent in 2003 to 55.4 percent in 2012 (WB 2013).

CHAPTER 3: METHODOLOGY

The following empirical research uses a survey method design to collect both quantitative and qualitative data. Data was collected in Santa Familia Village between February and December of 2012 in order to collect agricultural information from the central planting season beginning in May. A simple random sampling design was used to select 64 households from the village's 360 households using the 2011 Village Water Board Census. According to the United Nations Department of Economic and Social Affairs (2008), a household can be defined as:

A group of two or more persons living together who make common provision for food and other essentials for living. The persons in the group may pool their resources and may have a common budget; they may be related or unrelated persons or constitute a combination of persons both related and unrelated (100).

As such, participating household heads, both male and female, were given the freedom to exclude individuals living within the home unit that did not share resources or eat together on a regular basis, as well as include individuals working in other areas of the country who share a common budget and support the livelihood security of household members (details described below). Village households were informed about the nature and confidentiality of the study prior to consenting, and interviews were conducted in either Spanish or English at the home site for 1 and 3 hours, with subsequent visits to complete or clarify questions.

3.1 Primary Source Data Collection

Mixed methods were used to collect information on the livelihood strategies of different household types, to assess levels of food and land tenure insecurity, and to understand the agricultural practices and interests of food-producing households. Primary data collection methods used in this study include face-to-face semi-structured interviews, participant observation, informal informant interviews, and extra-local formal interviews with government officials.

Semi-structured face to face interviews

A semi-structured survey was used to collect both quantitative and qualitative data. Relevant quantitative data collected includes household size, off-and on-farm income, home-lot and on-farm crop types and quantity, land and farm size, grain volumes and months of subsistence. Qualitative survey questions, on the other hand, were used to capture household perceptions on livelihood security and family food production practices, the extent to which households have increased production in recent years, and what householders perceive as their personal obstacles, as well as specific opportunities, for improving family food production capacity (see Appendix C-E). Open ended questions were used in the survey as a means of allowing participants to respond in their own words, encouraging deeper reflection and gaining new insight into alternative perspectives and related topics not previously considered (Rubin and Babbie 2008).

The author spent several weeks in the village prior to interviewing to become familiar with the cultural and physical geography of the community. Survey questions were first tested in a nearby village and then further refined in the field in order to more effectively capture relevant data and account for details not yet foreseen. Interviews were conducted at the home site with both male and female household heads who participated in different sections of the survey. In cases where females were not present or did not wish to participate, the household male head completed the survey. In cases where the male was not present and the female head did not feel she could sufficiently provide the data, the interview was postponed to a later date. Single parent household heads completed the entire survey, often in two visits. In the process of interviewing, probes were used as necessary to encourage elaboration and clarification, while ground-truthing was conducted by reiterating the interpretation of qualitative data to ensure the accuracy of responses. The author also returned to each farming household after harvests were completed in order to obtain total estimates (i.e. number of 100lb grain sacks) and to record the amount intended to be saved and sold.

Participant observation

To complement the interviews and fulfill other research objectives, the author engaged in participant observation with six farming households to validate claims and explore cultural meanings and values in practice. Practices in which the author participated included the preparation, planting and harvesting of farm crops, the cleaning, storing and selling of grains, and the preparation of traditional foods with village women. Such first-hand experience is considered critical for gaining deeper insight into the subjective processes that influence personal motivation and cultural practices (Creswell 2007). Participant observation

was conducted in a focused manner using field notes and purposive conversations to not only record how planting sites are selected, prepared, and harvested, but to also to reflect upon the cultural, political, and ecological themes that were interrelated with these practices. This mode of data collection proved invaluable in adding cultural context to the survey data and revealing more deeply the variations in practices and perspectives among food producers.

Key informant interviews

Rubin and Babbie (2008) note that the use of key informants allows the researcher to gather the opinions of experienced individuals as they relate to the problems and needs of the target population. Village informants were consulted in this study to gather general information on the village prior to conducting research as well as during the data collection process. The author consulted with four key informants in July of 2011, identified through word of mouth, including the village chairman, some female household heads, and local food producers to obtain a general sense of the socioeconomic conditions in the village, the basic diets of villagers, and the extent to which households produce food for family consumption. Informants were again consulted and diversified during the research process in 2012 to collect different kinds of information to contextualize the study site, where new informants were identified based on their historical knowledge of the area, awareness of local family values as they relate to food and nutrition, and their specific orientation in commercial food production. These included consultation with elders, as well as a farmer met through the surveying process itself, based on the farmer's level of knowledge related to specific types of food production (e.g. commercial white corn market opportunities, prices for certain non-grain products). Informant questionnaires, while structured, were informal in nature and gave

sufficient space to participants to discuss perspectives and peripheral topics of interest to both the informant and the author.

Extra-local interviews

The author conducted extra-local interviews with government officials to supplement collected policy data and shine light upon the conceptual frameworks and action plans developed by recent administrations. Formal and informal interviews were conducted with several officials from the Ministry of Agriculture at Belmopan and Central Farm, the Ministry of Economic Development, and the Department of Rural Development. The author also attended cooperative meetings and workshops on the periphery of the village, conducting formal interviews with cooperative members to understand the rules governing access to physical and knowledge-based resources, as well as to gather alternative perspectives on the history and current mission and vision of cooperative projects.

3.2 Secondary Source Data Collection

To fulfill the third objective of the study, secondary sources were collected from government institutions and websites to obtain updated information on current policies related to food security and agriculture. In addition to primary sources such as household and agricultural census data and poverty assessment reports, grey literature focusing on current food security initiatives and agricultural development are also referenced. Food and agricultural development reports were reviewed to gain an understanding of the relative importance of gardening initiatives and the activities of small subsistence and commercially

oriented farmers in current policy agendas. Scholarly journal articles analyzing these topics are also used to contextualize the study as they pertain to food and agricultural policy at different scales and historical periods.

3.3 Data Analysis

Data from interviews and field notes were transcribed into Microsoft Excel spreadsheets in order to organize socio-economic, cultural, and food production data. The results were then coded and statistically analyzed using SigmaXL. Given that the population distributions of dependent variables cannot be assumed to be normal, nonparametric test methods were utilized to test whether the observed relationship in the sample were due to chance and to make statistical inferences about the larger population (Corder and Foreman 2009).

Pearson's Chi Square

Three common representative tests were used to analyze the data. The Pearson's chi square goodness-of-fit test and test of independence were used to determine how well sample proportions fit the population proportions. The chi square goodness-of-fit test was used for single nominal variables with two or more mutually exclusive categorical or interval variables to test the null hypothesis that the observed deviations were attributed to chance. This is determined by comparing observed frequencies (f_o) with expected frequencies (f_e) using the formula:

$$x^2 = \sum(f_O - f_E)^2 / f_E$$

Because expected values for population proportions are unknown, this study uses an equal probability null hypothesis for the goodness-of-fit test where expected values are no less than 5.

The Pearson's chi square test of independence was used to test the potential association between two or more nominal or interval variables. This test uses the same equation as the chi-square goodness-of-fit test to compare observed with expected frequencies within a contingency table, where no more than 20 percent of expected values are less than 5. For any 2 x 2 contingency tables where expected values were less than 5, a 2-sided Fisher's exact test (FET) was used to ensure accuracy of the results (Corder and Foreman 2009).

Mann-Whitney U-Test

The non-parametric Mann-Whitney U-test, also known as the Wilcoxon rank sum test, was used to compare median values between 2 independent samples using ordinal data. This test converts the individual values observed within each group into ranks in order to determine how different the ranked totals are between groups. The Mann-Whitney tests conducted in this study are one-tailed, where the alternative hypothesis states that the observed total in one group is greater than the observed total in the other. If the null hypothesis can be rejected, then it is expected that the difference in values between the two groups is large enough to be statistically significant and not the result of sampling error (Corder and Foreman 2009)

CHAPTER 4: STUDY SITE

4.1 The Biogeographical, Cultural, and Socioeconomic Environment

Santa Familia Village is located in the Upper Belize River Valley on the western end of the Cayo district. The village is situated along the Belize River between the town of San Ignacio and the Mennonite agribusiness center of Spanish Lookout (see Figure 3). The predominantly karst topography of the area has produced relatively fertile soils composed of phosphorous-limited mollisols in the well-draining uplands that are highly productive under appropriate hand cultivation systems[1]; with deeper, slow-draining vertisols and mollisols in the lowlands that create both permanent and seasonal wetlands (Fedick and Ford 1990). Vegetation in the uplands is made up of subtropical broadleaf forest with scattered seasonally dry trees, while the dominant vegetation in the lowlands is high marsh forest with a variety of palms (Wright et al 1959). In addition to providing resources to local households, the forests surrounding the village also provides habitat for a diverse array of species, including the keel-billed toucan (*Ramphastos sulfuratus*), the jaguar (*Pantera onca*), ocelot (felis pardalis), tapir (*Tapirus bairdii*), the black howler (*Alouatta pigra*) the spider monkey (Ateles geoffroyi), and the Yucatan brocket deer (*Mazama pandora*)[2]. The climate is hot and humid year round, with the dry season ranging from January to late May and the rainy season beginning in June. Mean rainfall measurements taken from the Spanish Lookout weather station ranges from 40 millimeters (mm) in April to 215 mm in July (BNMS 2013).

[1] Well-draining upland karst soils are fertile, dark colored and rich in organic matter with textures ranging from friable clay to clay loam. Yields on these mollisol soils are unsurpassed by those of other unirrigated areas and, while they represent the dominant soil type of the Maya Lowlands, constitute only 1 percent of the world's tropical soils (Fedick and ford 1990).

[2] Informant 1, village ecotourism guide, personal communication, February 10, 2012.

Figure 3: Santa Familia Village, Cayo, Belize

Occupation of the Belize River Valley dates back to the ancient Maya, who began altering the valley landscape as early as 1100 B.P. and in Belize's lowlands more generally as far back as 5000 B.P using a mosaic of intensive and extensive cultivation systems adapted to distinct land types (Chase and Garber 2004, Fedick and Ford 1990, Pohl et al 1996). Along with the Maya descendants of Tipu who originally inhabited the valley, mestizos and Yucateca Maya later populated the northern and western regions of Belize

during the Caste War (1847-1901) and took refuge with other Maya groups escaping British enslavement in the east. Self-sufficient agriculturally based communities existed after the decline of the Mayan empire and continued to thrive and independently profit from agricultural trade during British settlement until their integration into colonial land systems as tenant farmers in the late nineteenth century (Bolland and Shoman 1977, Bolland 2003). While Santa Familia was initially founded by an afro-Belizean family in the early 1900's, land conflicts further north contributed to significant settlement by mestizo families. As the population increased, the colonial government redistributed local lands to encourage formal leaseholds, which remains the common tenure system to this day[3].

The Spanish-speaking[4] householders of the village continue to engage in both on and off-farm activities to make a living. Traditionally, households made their living in the forestry sector extracting hardwoods, including logwood (*Haematoxylon campechianum*), mahogany (*Swietenia macrophylla*), and chicle (*Manilkara zapota*) for the market[5]. While some households also profited from cattle ranching activities, the majority engaged in grain production for family subsistence, where surpluses were sold for income to the state-run Marketing Board in San Ignacio until district purchasing activities ceased in the mid 1980's[6]. Today, the relative proximity of the village to major towns has helped to provide households with a diverse set of employment opportunities ranging from agriculture, forestry, and mining to construction, tourism, and service jobs (NHDAC 2010). As a result, livelihood strategies vary among households and range from full formal employment to more sporadic

[3] Informant 2, village elder and subsistence farmer, personal communication, March 10, 2012.
[4] The Spanish language in Cayo villages incorporates Yucateca and Guatemalteca Maya vocabulary to describe various human expressions and the local flora and fauna, with some words only expressed in Creole.
[5] Informant 2, village elder and subsistence farmer, personal communication, March 10, 2012.
[6] Informant 2, village elder and subsistence farmer, personal communication, March 10, 2012.

day labor, with many producing food on home lots and farmland for subsistence and/or commercial purposes.

Recent ecological and economic stresses and shocks, however, have adversely impacted the Cayo district and rural livelihood security. The economic downturn in the country between 2002 and 2009 increased the unemployment rate to 17.8 percent and contributed to a 13.2 percent rise in poverty where indigence levels more than doubled. 40.6 percent of the population and 22.7 percent of households now live below the poverty line, accounting for 21 percent of all poor households in the country[7]. Poverty in the district is concentrated in the countryside where it afflicts half of the rural population, with 18 percent of rural people unable to adequately feed themselves[8]. Food price inflation has been felt in the village by straining household incomes, even while higher prices for grains has been seen as an economic opportunity for farmers[9]. Such conditions have translated into increased food insecurity as one third of all households and half of all poor households in the country now worry about the inability to sufficiently feed their families (NHDAC 2010).

Contributing to economic instability was a tropical depression that hit the district in 2008 and led to massive flooding and grain crop devastation in Santa Familia Village. In response, the World Bank's Global Environmental Facility's (GEF) Small Grants Program awarded the Santa Familia Grains, Vegetables, and Legumes (GVL) Cooperative with a USD

[7] The general poverty line for a household of three people in the Cayo district is BZD $3,537.00 dollars (NHDAC 2010).
[8] The Minimum Cost Daily Food Basket in the Cayo district is BZD $4.91 or $1,791.00 per year for one adult male. Minimum household food requirements are calculated by adjusting for the household's age-sex composition (NHDAC 2010).

[9] Informant 2, village elder and subsistence food producer, personal communication, March 10, 2012.

$50,000 grant. The objective of the grant was to enhance village food security and rehabilitate riparian areas by providing support for sustainable agricultural production (GEF 2008). Because cooperative members make up only a small fraction of village farmers, however, the majority of the village's food producers had to rely on seed and fertilizer recovery support from the government, which was either slow or non-responsive in tending to household needs due to political interference[10]. In addition to being vulnerable to extreme weather, Santa Familia is also one of several villages threatened by the breaking of the Chalillo dam in the upper Macal River. Both the breaking of the dams and the mercury buildup in the river resulting from their construction contribute additional risk to lowland agriculture, in addition to general health and security[11].

While it can be argued that small food producers need not be fully integrated into the labor market to secure adequate livelihoods (Netting 1993), Santa Familia, like many other rural villages in Belize, suffer from underemployment due to a lack of sufficient on and off-farm income opportunities to keep up with rising costs of living. Updates from the 2011 Agricultural Census estimate 3,220 farms are located in the district, helping to provide food and/or income to local households (Tate 2013). While the rate of the rural population completing secondary education is on the rise, slow economic growth and a small domestic market to supply agricultural products has translated into constrained opportunities and greater dependency on day labor employment as a source of income, inducing householders to labor in nearby towns as well as migrate to the north and the south of the country in search of work. Difficulty in finding consistent wage work, however, has resulted in many

[10] Informant 5, commercial hybrid corn producer, personal communication June 6, 2012.
[11] Al Wesby, district National Emergency Management Organization (NEMO) representative, personal communication, November 28, 2012.

remaining idle through the day, relying on small jobs at the village level, or working more days on family farms for subsistence and commercial purposes[12].

4.2 Household Structure and Diet

In Santa Familia, nuclear and extended family relationships are the center of social life. Both male and female household heads, along with working age members, work to support the everyday functioning of the household. While household male heads work for wages or on the farm, female heads, if not working for wages themselves, typically run the family home, delegating responsibilities to household members and ensuring home needs are met. Central household expenditures include utility costs, as the majority of villagers have access to water and electricity, as well as the educational costs of children. Children within the home often support household heads until they are married. While resources are pooled together for food and to invest in home or small business development, working members also direct their resources into building homes of their own, which takes place within the lot(s) held by the central household[13].

Because families are continuously in the process of developing their homes, saving for education fees, paying bills and debts, and investing in future activities, the daily consumption of rice and beans continues to provide a low cost means of ensuring sufficient food for all members. Flour and corn tortillas, white bread, eggs and meats of varying quality are also common to village diets at both ends of the socioeconomic spectrum, along with

[12] Enrique Quiróz, Village Chairman, personal communication, March 17, 2012.
[13] Informant 3, female householder, personal communication, April 11, 2012.

imported staples, such as cooking oil, butter and powdered/canned milk. Other imported products, ranging from canned meats and ramen noodles to cheese whiz and chocolate, are also consumed either due to their relative convenience or popularity as culturally modern and relatively expensive treats. Alcohol is also relevant to this category, and is often consumed at the expense of improved food diversity[14].

When it comes to the consumption of fresh fruits and vegetables, households vary in their capacity to purchase and produce sufficient quantities for nutritional balance. While a large amount of households rely solely on village shops as a means of procuring food, where prices are higher and where credit is available, others commute by village bus, bicycle, or family car to San Ignacio and Santa Elena to secure the cheapest price for everyday food goods, including fruits and vegetables from the market. Nevertheless, market prices relative to family consumption needs are high and the daily portion of commonly consumed vegetables, such as cabbage, potatoes, tomatoes, and sweet pepper is typically meager (see Appendix F). However, a variety of local fruits and vegetables are accessible at the village level, including mango, coconut, lime, plantain, okra, taro, cassava, squash and sweet potato, through home gardens and family networks. Interestingly, while traditional and nutrient rich leafy greens are also common in household lots, such as chaya (*Cnidoscolus acontifolius)* and to a lesser extent callaloo (*Amaranth spp*.) and hierba mora (*Solanum nigrum*), the consumption of greens is much less than what is readily available due to changing food preferences, often making their consumption a result of physical ailments, such as diabetes, rather than a means of preventing sickness[15].

[14] Informant 3, female householder, personal communication, April 11, 2012; Personal Observation.
[15] Informant 3, female householder, personal communication, April 11, 2012, Personal Observation.

Today, the increasing consumption of inexpensive foods high in fat, salt and sugar also affect the nutritional and overall health status of villagers. When meals are not prepared from home, individuals choose between purchasing low cost fast foods that are often deep fried, such as fried chicken, *salbutes*, and *empanadas*, or more wholesome meals at higher prices. Fried fast foods are becoming more popular not only due to convenience and relative cost, but also due to changing cultural values concerning food. In addition to the consumption and sale of traditional corn-based dishes such as *tamalitos* and *boyos*, woman in the village often generate additional income through the sale of fast foods on the weekends[16]. Adding large quantities of oil and shortening to family dishes also helps keep the belly full without squeezing the budget. Foods high in fats are usually followed by the consumption of sugary drinks, such as sodas or artificial juices, and salty snacks as cheap as a Belizean *shilling* (0.25USD), which are all too often relied upon in keeping children full throughout the day[17].

4.3 Off-Lot Food Production

Many village households have access to land through either the nuclear or extended family, which is utilized to cultivate food, raise cattle and source timber and non-timer forest products. Male householders typically manage food production outside of the home lot, though both male and female members may play roles in preparing, planting, maintaining and harvesting crops. Off-lot food production takes place both within the village and near the

[16] Informant 3, female householder, personal communication, April 11, 2012.
[17] Personal Observation.

riverside, as well as at the base of, and inside, the low-lying mountains to the north. Food cultivation by hand using a digging stick (*macana*) is commonplace, though farmers producing under both permanent and shifting cultivation in the lowlands also rely on basic machinery for plowing and planting. Upland farms are typically cultivated on larger landholdings and tend to be shifting in nature. While the term *milpa* is traditionally associated with long-fallow swidden farms centered on the production of corn, beans, squash and other indigenous cultivars, the use of the term today is synonymous with small farms producing crops of various types under both non-intensified and intensified systems[18].

There are 3 cropping seasons in Santa Familia Village: the *Cosecha, Yaxk'in*, and *San José*. Because farmers largely lack irrigation, the central planting season (*La Cosecha*) begins in May through mid-June depending with the start of the rainy season. Farmers also take advantage of the second rainy season beginning in September after the dry season of August (Yaxk'in) for bean production as well as to make up for lost crops or simply generate greater corn output for the family or market. The *San José* period can be considered an early extension of the central planting season, beginning as early as March, due to the moisture content of soils near the river and in seasonally inundated karstic depressions (*bajos*) that remain moist during the dry season and become too wet for later planting. While *bajos* are valued because they extend cropping cycles and allow grain farmers to reap corn during off-seasons when purchasing prices are higher, less experienced farmers, or those who have difficulty planting at the ideal time, risk crop failure as heavy rains often drown young corn stalks[19].

[18] Personal Observation.
[19] Informant 4, commercially-oriented local corn producer, personal communication, May 20, 2012.

Both local and hybrid corn varieties are cultivated in the village, the former taking up to 4 months to mature, while the latter taking only 3 months. For such reasons, both corn types are valued for providing fresh and dried corn at different times of the year. Local corn, valued for its storability, texture in tortillas, relatively high purchasing price, and productivity in the absence of fertilizer inputs, is preferred by many small households, who often have smaller plots dedicated to hybrid corn. Local corn is often intercropped with local squashes, such as *siquíl* or *ayote*, and to a lesser extent local beans, with fruits and root crops also produced on site. Corn is typically stored in its husk (*jolóch*) in wooden *trojas*, or raised sheds, near the home where they are kept dry and covered in white lime (*cal)* and/or insecticide to repel pests. Food stores beyond the consumption capacity of the household are typically shared with extended family or sold, either in local villages or to tortilla factories in San Ignacio. Many food producing households who are not solely dedicated to farming continue to produce food even as work becomes available, often paying local villagers to look after crops[20]. However, as male householders get older and invest less time in locating off-farm work, it is customary for them to return to the land and dedicate more time to agriculture[21].

Some commercially-oriented farmers, on the other hand, produce larger quantities of hybrid corn that is sold in relatively large volumes at market price mainly to feed mills in Spanish Lookout. Village households have not only become increasingly reliant on the modern Mennonite town of Spanish Lookout for employment, but Spanish Lookout has also

[20] Informant 4, commercially-oriented local corn producer, personal communication, May 20, 2012.
[21] Informant 2, village elder and subsistence farmer, personal communication, June 1, 2012.

become the country's central producer and purchaser of grains, making it a primary agribusiness destination in the country (Roessingh and Schoonderwoerd 2005). As such, Spanish Lookout is a central supplier of seed, fertilizer and other agro-inputs for the district, one of a small handful of distributors nationwide. When it comes to fertilizer, only one company, Monsanto's Prosser Fertilizer and Agrotech Company Ltd, imports and processes the synthetic input to supply national demand[22]. With the retreat of public agricultural services, non-mechanized commercial oriented farmers in the village have also come to rely on the town for private machine rental services in order to prepare, plant, harvest, transport, and dry their grains[23].

In addition to food production, land resources are used as a source of timber and non-timber forest products. Timber extraction by landed households is less frequent today due to the scarce amount of mature hardwoods, but continues as a livelihood strategy, especially to generate immediate cash. Local hardwoods harvested include santa maria (*Calophyllum brasiliense*), malerio (*Aspidosperma megalocarpa*), chico zapote (*Manilkara zapota*), manchich (*Lonchocarpus castilloi*), granadillo (*Platymiscium dimorphandrum*), jobillo (*Astronium graveolans*), ziricote (*Cordia dodecandra*), purple heart (*Peltogyne spp.)*, and bullhuff (*Drypetes brownii*). In addition to wooden planks and smaller posts used for home and farm construction, and as raw material in informal construction businesses, firewood is also sourced from the forest to subsidize the cost of fuel for cooking beans, rice, corn and other staples. Besides timber, palms such as bay leaf (*Sabal mauritiiformis*) and cohune (*Orbignya cohune*), are harvested to repair thatched kitchens and storage units, as well as to

[22] Company Manager, Midwest Steel & Agro Supplies, personal communication, Novermber29, 2012
[23] Informant 5, commercial hybrid corn producer, personal communication September 10, 2012.

supply demand from the tourism industry. Bush meat, such as wild turkey, iguana, paca, and deer, are also consumed as a rare delicacy and in times of need.

Amid the diversity of land-based activities, the land tenure status of households in the Cayo district are overwhelmingly in leasehold status. The introduction of state leaseholds in the 1960s eliminated open access forests use (Clark 2000). Unlike households in other districts who are more likely to own freehold land (with the exception of Toledo), the majority of households in Cayo continue to occupy Crown lands owned by the state (NHDAC 2010). In order to formally claim the land as freehold property, families must first survey and register their land parcels after approval from the village and area representative, pay an annual leasing fee for a particular number of years while proving development of the land, and then secure the funds to purchase the land as property (Iyo et al 2003, GoB 2003). After meeting all the aforementioned requirements in a timely fashion, households must wait out the process with little knowledge over the status of their application, not only because villagers have limited resources and knowledge of the process, but also due to the slow processing time by the Land and Surveys Department. While many villagers qualify as long-occupied "squatters," not only are most households unaware of squatter's rights laws, but in order to utilize them householders must actively prove occupancy of the land after a minimum of 30 year of residency (GoB 2003). Longstanding land claims, however, continue to be recognized by villagers at the local level, where open access to certain resources remains commonplace.

CHAPTER 5: RESULTS

5.1 Village Demographics and Income Levels

Out of the 64 households surveyed, 75 percent were not producing corn, beans[24], rice or other grains outside of their home lots, while 25 percent of households were actively producing grains during the main planting season in 2012 (see Table 1). Households not producing grains outside of their home lot, termed "non-grain households," nevertheless cultivated an array of food crops in their home lots. However, it is important to note that production fluctuates over the years as 21 percent of non-grain producing households interviewed indicated they farmed grains within the past 5 years. Of those producing grains during the main agricultural season beginning in May of 2012, 69 percent of the sample were engaged in off-farm wage work for at least part of the year, with 31 percent generating income solely from on-farm activities, although these differences are not significant. Nevertheless, not only is part-time farming considered the norm in Santa Familia Village[25] and statistical inferences can be obtained from the part-time farming sample as this population, and the grain-farming population in general, contrast significantly in many ways with non-grain households.

Table 1. Sample Size by Household Type

Household Type	Number of Observations	Percent of Village
All Households	64	100

[24] Legumes in this study are categorized as grains.
[25] Informant 2, village elder and grain farmer, personal communication, March 10, 2012.

Non-Grain Households	48	75
All Grain Farmers	16	25
Part-time Farmers	11	17
Full-time Farmers	5	8

The large majority, 97 percent, of all village householders have at least one household head that is originally from the village, including 81 percent of all grain farming households, with the remainder of grain farmers originating from Guatemala. The median number of years farming for grain producing households was 24.5 years, with 20 years for part-time farmers and 30 years for full-time farmers ($p > .05$). For male householders, 75 percent had attended primary school, but had no high-school or higher education. 65 percent of non-grain male householders did not receive education above the primary school level, while all grain farmers completed some or all primary education only (Chi = 59, df = 1, $p < .01$, FET).

The median age of male grain farmer heads is significantly older than that for non-grain producers, at 54 and 38, respectively ($U = 623$, $n_1 = 16$, $n_2 = 43$, $p < .001$) (see Table 2). Grain farming households have a greater median number of total household members compared to non-grain farming households, at 6 and 5 respectively ($U = 638$, $n_1 = 16$, $n_2 = 48$, $p < .05$). They also have more additional earners within the household compared to non-grain farming households, with a median of 1 and 0, respectively ($U = 667$, $n_1 = 16$, $n_2 = 48$, $p < .005$). Taking both male and female household head income sources together with the number of additional household earners, grain-farming households have a slightly higher median number of household income earners compared to non-grain households, at 2.5 and 2 respectively ($U = 678$, $n1 = 16$, $n2 = 48$, $p < .005$).

Table 2. Age, Family Size and Income Earners by Household Type

Household Type	Male Head Age	Female Head Age	Family Size	Head Earners	Additional Member Earners	Total HH Earners
All Households	42	38	5	1	0	2
Non-Grain Households	38***	36	5*	1	0	2**
All Grain Farmers	54***	49	6*	1	1	2.5**
Part Time	54	48	6	1	1	2
Full Time	56	52.5	7	1	1	3

* $p < .05$, ** $p < .01$, *** $p < .001$

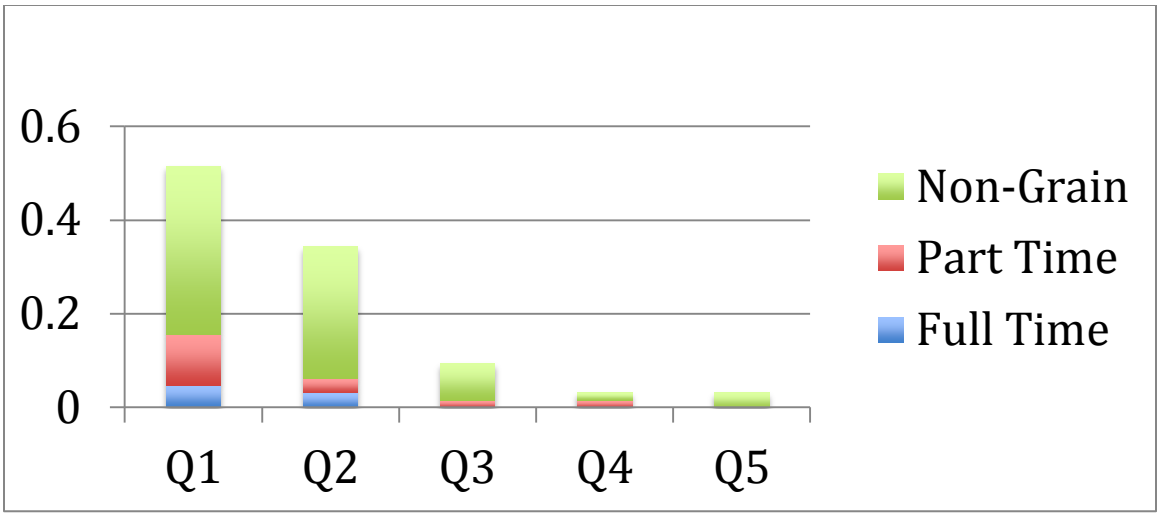
Survey data on annual income shows no significant difference in *total* household income between household types. However, the median income of non-grain male household heads is significantly greater than that of grain farmer male householders ($U = 1393$, $n_1 = 43$, $n_2 = 16$, $p < .05$) (see Table 3). There is no significant difference between household heads income when female income sources are included. Though, 41 percent of female heads sampled engaged in income generating activities, median income generated by all working female householders is significantly less than that of their male counterparts ($U = 3131$, $n_1 = 26$, $n_2 = 60$, $p < .001$). Income generated by female household heads is nevertheless important and will be discussed later.

Table 3. Annual Income by Household Type

Household Type	Median Total Income	All Heads Income	Male Head Income	Female Head Income
All Households	11,207.50	7,955.00	7,890.00***	780.60***
Non-Grain Households	10,732.00	8,128.40	8,210.00*	764.00
All Grain Farmers	12,026.00	6,426.00	5,568.00*	1,200.00
Part Time	12,250.00	6,340.00	5,860.00	652.50
Full Time	11,215.00	3,550.00	710.00	4,795.00

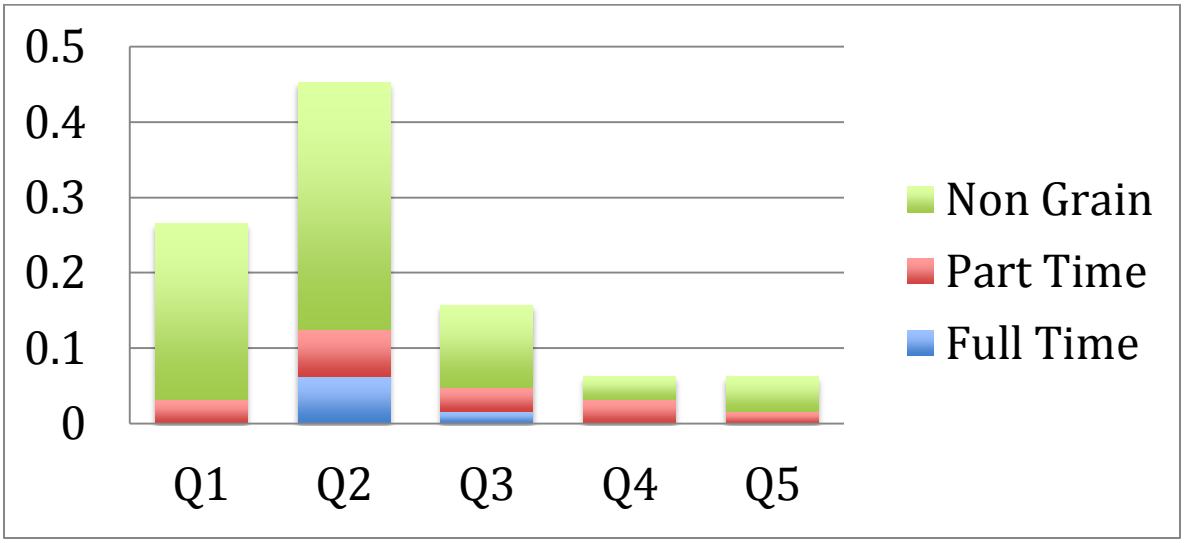
*p < .05, **p < .01, *** p < .001, *All currency in BZD dollars*

Total household and household head income by quintiles shows that all households are primarily distributed in quintiles 1 and 2, the lowest income levels for the village. When considering male and female householder income alone, 50 percent of village households fall into quintile 1, while 34 percent fall into quintile 2 (Chi = 57.2, df = 4, p < .05) (see Figure 4). For non-grain households, 46 percent of householders fall into quintile 1, with 38 percent falling into quintile 2 (Chi = 39.3, df = 4, p < .0005). The distribution of grain-farming household heads, with 62.5 percent of the sample falling into quintile 1, is not statistically significant due to insufficient sample size. When considering total household income, 26.5 percent of all village households fall into quintile 1 while almost half, 45 percent, fall into quintile 2 (Chi = 131.48, df = 4, p < .05) (see Figure 5). For non-grain households, 31 percent remain in quintile 1 when considering all household income, while 44 are concentrated in quintile 2 (Chi = 27.8, df = 4, p < .0005). The income distribution between grain-farming households is not significant.



Q1: 0-8,000BZ; Q2: 8,000-16,000BZ; Q3: 16,000-24,000BZ; Q4: 24,000-32,000BZ; Q5: 32,000-40,000BZ

Figure 4: Household Heads Income by Quintile



Q1: 0-8,000BZ; Q2: 8,000-16,000BZ; Q3: 16,000-24,000BZ; Q4: 24,000-32,000BZ; Q5: 32,000-40,000BZ

Figure 5: All Household Income by Quintile

Domestic and foreign remittances did not impact the majority of participants, as only 28 percent reported they received, or would receive, some amount of extra-household monetary support in 2012 (see Table 4). 25 percent of non-grain farming households received extra-household monetary support, while 37.5 percent of grain farmers were recipients, with no significant difference between household types. Out of those receiving remittances, the

median value of out-country remittances were significantly greater for non-grain households compared to grain farmers ($U = 21.00$, $n_1 = 4$, $n_2 = 3$, $p < .05$). There was no significant difference between the median values of in-country remittances between household types. In addition, there was no significant difference between the median value of in-country and out-country monetary support.

Table 4. Out-country and In-country Remittances

Household Type	Out-Country	In-Country	Total Annual Support	Percent Receiving
All Households	1,000.00	1,920.00	1,500.00	28
Non-Grain Households	1,400.00*	1,860.00	1,500.00	25
Grain Farmers	300.00*	2,800.00	1,800.00	37.5

* $p < .05$

5.2 Male Householder Livelihood Strategies

Male income sources

Livelihood strategies in Santa Familia Village are diversified. Village household male heads engaging in income generating activities, irrespective of household type, are primarily distributed in construction (24 percent) and general day labor (20 percent), which includes non-permanent employment in agriculture, forestry, and non-agricultural wage sectors[26] (Chi = 34.34, df = 10, $p < .001$). Non-grain households are more heavily distributed in construction-related work, wage work in the agricultural industry, and in general day labor

[26] These proportions are based on work from within the country only. Subsequent descriptions include work abroad.

compared to other types of primary income sources (Chi = 16.21, df = 8, $p < .05$) (see Table 5). 54.5 percent of grain farmers with at least one off-farm income source (i.e. part-time farmers), on the other hand, indicated day labor as their primary source of income, which ranges from farm related work to landscaping and home repairs, though differences between proportions is not significant due to insufficient sample size. Nevertheless, day labor, along with construction, remain key sources of income for part-time grain farmers (see Table 6).

Compared to non-grain households, part-time grain farmers are disproportionately engaged in general day labor (Chi = 57, df= 1, $p < .01$, FET). The median day wage for day labor employment is significantly lower than that of construction-related work, at BZE $32.50BZ[27] and $40.00 respectively (U = 259, n_1= 14, n_2 = 12, $p < .001$). The median days per week worked by day laborers (*jornaleros*) is also significantly lower than those engaged in construction as their primary income source, 2.5 to 4.5 days respectively (U = 219.5, n_1= 13, n_2 = 12, $p < .001$). Of the two most common off-farm income categories for all household types, general day labor is less reliable and pays less.

Table 5. Primary Income Sources of Non-grain producing Households

Employment Type	Percent	Income per Day	Days per Week	Months per Year
Construction	26	40.00	4.5	10
Agricultural Industry	15	34.00	5	12
Day Labor	13 **	32.50	3.5	10.5
Sawmill/Logging	8.7	32.50	4	7

[27] 32.50BZ is the median value for *all* day laborers. The median value for grain farmers, specifically, is 31.00BZ.

Non-Ag Wage Work	13	50.00	5	12
Lot Crop Farming	4	--	--	--
Rents Land	4	--	--	--
Abroad	4	--	--	--
Other	10	--	--	--

*** $p < .001$

Table 6. Primary Income Sources of Grain Farming Households

Employment Type	Percent	Income per Day	Days per Week	Months per Year
Day Labor	54.5**	31.00	2	10.5
Construction	18	42.50	4.5	6.5
Other	27	--	--	--

**$p < .01$

Male household heads engaging in a secondary income generating activity (n = 34) accounted for 58 percent of all village households in the sample. Half of non-grain households and 64 percent of part-time farmers depended on a second *off*-farm income source (see Tables 7 and 8). For all household types in a secondary livelihood strategy, household male heads are more likely to be engaged in general day labor (30 percent) and seasonal work (26.5 percent) as alternative livelihood sources compared to all other activities (Chi = 11.18, df = 5, $p < .05$).

Table 7. Secondary Income Sources of Non-grain producing Households

Employment Type	Percent of Total	Income per Day	Days per Week	Months per Year
Day Labor	43.5	32.5	3	6
Seasonal Ag Work	26	[550.00 yr]	--	--
Rents Land	13	[150.00 yr]	--	
Other	17	--	--	--

All annual estimates are median amounts in BZD dollars

Table 8. Secondary Income Sources of Grain Farming Households

Employment Type	Percent of Total	Income per Day	Days per Week	Months per Year
On-farm Food Production	36	[2,025.00yr]	--	--
Seasonal	27	[800yr]	--	--
Small Business	18	[1250yr]	--	--
Other	18	--	--	--

All annual estimates are median amounts in BZD dollars

Household male heads engaging in a tertiary livelihood strategy (n = 17) accounted for 29 percent of all male household heads. Out of the small sample of male household heads participating in a third livelihood strategy, non-grain producing households (n = 8) engaged in seasonal work, personal service businesses, personal logging activities, and on-lot microlivestock sales (see Table 9). The majority of part-time farmers with a third livelihood strategy (n = 9) engaged in on-farm food production as their third income generating activity, while part-time farmers who produced food as their secondary strategy engaged in the sale of bush meat and personal logging activities as their tertiary strategy (see Table 10).

Table 9. Tertiary Income Sources of Non-grain producing Households

Employment Type	Percent	Income per Day	Days per Week	Months per Year
Seasonal Work	25	[728.00yr]	--	--
Personal Logging	25	[750.00yr]	--	--
Other	50	--	--	--

All annual estimates are median amounts in BZD dollars

Table 10. Tertiary Income Sources of Grain Farming Households

Employment Type	Percent	Income per Day	Days per Week	Months per Year
On-farm Food Production	66	[1220.00yr]	--	--
Bush Meat Sales	22	[285.00yr]	--	--
Personal Logging	11	[3000.00yr]	--	--

All annual estimates are median amounts in BZD dollars

Female income sources

Over 40 percent of female household heads sampled (n = 26) indicated that they were engaged in income generating activities. This accounts for 40 percent of non-grain households and 44 percent of grain farming households, with no significant difference between household types. When inquiring if women were working out of necessity, 79 percent of working non-grain females indicated working as a matter of necessity, while 57 percent of working female farmer heads indicated this to be the case, with no significant differences between the two. Educational attainment is low among both household types, as

91 percent of all female heads have only full or partial primary-level education. 85 percent of working women generated their income through informal work exclusively. Among the informal income activities, 54.5 percent sold lot crops, including habaneros, okra and avocado, and/or processed foods, including boyos, tamalitos, empanadas, candied fruit, root and grain-based puddings, palm oil and natural and artificial frozen treats[28]. 82 percent of informal female workers stated that their work was a matter of necessity, while half of formal female workers sampled also indicated working out of necessity, with one participant engaging in both formal and informal work.

Consumption of forest resources

In Santa Familia, 5 percent of households stated that they generated income from the sale of bushmeat, including iguana, gibnut and river fish. This represents 2 percent of non-grain households and 12.5 percent of grain-farmers, though these proportions are not significant due to small sample size. When it comes to fuelwood, 91 percent of all villagers procure firewood from surrounding forest on average of 3 days of use per week. That includes 87.5 percent of non-grain households, with a median of 3 days of use per week, and 100 percent of grain farmers with a median use of 4.5 days per week[29], with no significant difference between household types.

[28] A small amount of households whose food-related income was generated from a member other than the household heads, such as elders and children, is not included in this analysis. Crop sales are calculated based on income generated in 2012 only, which includes products harvested in late 2011.

[29] Fuel wood use frequency reflects that most households own a gas burning stove, where large and slow cooking meals are made in outside kitchens to subsidize the cost of gas, as well as when gas is not available or economically accessible. This primarily includes beans, made in large amounts typically every other day, as well as other food items.

Total livelihood strategies

After including all male and female household head income strategies with all additional household earners, part-time farming households on average maintain a significantly higher number of income-generating strategies compared to non-grain households, median of 4 and 2 respectively ($U = 493$, $n_1 = 11$, $n_2 = 48$, $p < .001$). While extra-household monetary support pushes non-grain households into a higher number of income strategies, part-time farmers maintain the highest number compared to non-grain households, with a median of 4 to 3 respectively ($U = 506$, $n_1 = 11$, $n_2 = 48$, $p < .001$). Therefore, while all households benefit from livelihood diversification, it is especially important for part-time farmers.

Table 11. Total Livelihood Strategies by Household Type

Household Type	Male Head Activities w/o lot crop, micro-livestock, bushmeat and timber sales	Male Head Activities w/lot crop, micro-livestock, bushmeat and timber sales	With Female Head Formal and Informal Income Activities	With Additional Household Earner Activities	With Inside/Outside Monetary Support
All Households	1	2	2	3	3
Non-Grain Households	1**	2*	2*	2**	3***
All Grain Farmers	2**	2.5*	3*	4**	4***
Part-time	3**	3**	3**	4***	4***
Full-time	1**	1**	1	3	3

* $p < .05$, ** $p < .01$, *** $p < .001$

5.3 Village Food and Livelihood Security

Savings capacity

Over 75 percent of all households are unable to save money on a consistent basis. This is the case for 77 percent of non-grain households, and 75 percent of grain farmers, with no significant difference between household types. The inability of most households to save money reflects constrained financial capital assets and suggests that dislocations from the labor market may adversely affect food and nutrition security, and family wellbeing.

Table 12. Ability to Save by Household Type

Household Type	Yes	No
All Households	23	76.5
Non-Grain Households	23	77
All Grain Farmers	25	75
Part-Time	18	81
Full-Time	40	60

* $p < .05$, ** $p < .01$, *** $p < .001$

Reduction in meal size

The number of householders who indicated having to reduce the size of daily meals is high, but with no significant differences between household types (see Table 16). The large

majority of households reducing family meal size[30] in recent years have either never had to do so, or have not had to do so to such a degree at any time in the past. Non-grain households stated in an open question that they reduced meal size due to increasing food costs (31%), lack of reliable work (25%), constrained finances (16%), educational costs (12.5%), increasing needs of growing children (12.5%), low wages (6%), utility and fuel costs (6%), less earners in the home (6%), need to save money (3%), and crop failure in home gardens (3%). For grain farmers, this was the result of increasing food costs (31%), high costs of production (12.5%), job scarcity (12.5%), and limited local market demand and/or low producer prices (12.5%). As one farmer explained:

Before there was more family [to support], but things were cheaper. Now there is less family and things are much harder. Everything is expensive. We have to measure our food every day.

Table 13. Reduction in Meal Size by Household Type

Household Type	Yes	No	More so Today	Yes	No
All Households	61	39	All Households	95	5
Non-Grain Households	67	33	Non-Grain Households	94	6
All Grain Farmers	44	56	All Grain Farmers	100	--
Part-time	36	64	Part-time	100	--
Full-time	60	40	Full-time	100	--

* $p < .05$, ** $p < .01$, *** $p < .001$

[30] It is important to note that participants who have reduced meal sizes in recent years may not necessarily be vulnerable to food insecurity, as some participants with relatively high incomes also indicated a need to regulate food intake. Contrarily, many households with insufficient and very low levels of food consumption did not indicate they regulated meal sizes in recent years nor necessarily perceived themselves as food insecure.

Land holdings and tenure status

The land tenure status of village households is another key indicator of livelihood security. Of those households who claim the lot upon which they live[31] (n = 61), 43 percent hold formal leasehold status, while 44 percent have yet to acquire an official lease (Chi = 56.6, df = 4, p< .0001). Only a fraction of village households, 8 percent, are in the process of or have acquired official title to their home lot (see Table 14). Of households who commented in an open-ended question regarding their tenure arrangement (n = 16), high surveying costs (62.5%), confusing processes, too much paperwork and/or lack of response by the Department of Lands and Surveys (31%), political discrimination (19%), and high titling costs (6%) were noted (not mutually exclusive). Even households with official leases noted that leaseholds are only a first step towards ownership and merely serve as a form of tenure for households who cannot afford to purchase their land outright. This sentiment is clearly expressed by one participant, when he stated:

We didn't pay for two years, and after 27 years of paying they won't take our payment. They say we have to measure again, but we deserve property by now.

Table 14. Land Tenure Status of Village Lot and Extra-Lot Landholdings

Tenure Type	Lot (%)	All Extra-Lot Lands (%)	Non-Grain Households (%)	Grain Farming Households (%)
Lease Process	44***	40***	44*	37**

[31] A very small fraction of households in the sample rent land or occupy land that is not claimed by a household member.

Formal Lease	43***	57***	50*	63**
Title Process	2***	--	--	--
Formal Title	8***	3***	5.5*	--
Mortgage	3***	--	--	--

* p < .05, ** p < .01, *** p < .001, significance pertains to intra-group distributions.

The land tenure status of extra-lot lands is not different from that of village landholdings. For all households, 51.5 percent claimed additional extra-lot land assets with a median size of 50 acres. Of all extra-lot land parcels sampled, including multiple farmer parcels with different tenure status, 57 percent were in official leasehold, while 40 percent had yet to be registered, with only 3 percent of all extra-lot lands recognized as formal household property (Chi = 17.08, df = 2, p < .0005). Though not statistically significant, riverside and valley lands on the periphery of the village were largely under leasehold and title status, while the majority of holdings in the uplands, even while informally claimed, were yet to be formally registered. For some participants, a lack of secure tenure rights has spurred land conflict with outside actors claiming to have original rights to the territory (see Appendix G).

5.4 Lot Crop Production

The value of home gardens

Over 95 percent of non-grain households produced some amount of food crops in their home lots (n= 46) in addition to raising microlivestock in 2012 (see Table 15). This was the case for all grain farmers. Of all households with home gardens, 73 percent stated that food crops in home lots helped to support the family, either by adding dietary diversity and

improving health or reducing the need to purchase food. This was the case for 69.5 percent of non-grain households and 81 percent of grain farmers, with no significant difference between household types. Adding diversity and/or improving health accounted for 64.5 percent of all responses. Reducing the costs of purchasing food was indicated by 29 percent of all households with home gardens. Lot crops are also valued as an alternative form of income generation (13%), for providing provisions to extended family and neighbors (6%), for providing shade (6%), to set an example for children and avoid over-reliance on others (3%), to avoid pesticides (2%), and to maintain traditional practices (2%).

Table 15. Common On-Lot Plant and Animal Crops

Food Type	All Households (%)	Median Number	Non-Grain Households (%)	Median Number (%)	Grain Households (%)	Median Number
Coconut	73	4	66	4	94	4
Lime	62.5	2	56	2	81	2
Mango	61	3	52	2	87.5	3
Plantain/ Banana	58	11	58	10	56	70
Chickens	55	10	44	7	87.5	17.5
Plums	55	2	52	2	62.5	2
Avocado	52	3	46	2.5	67	3
Nance	52	2	46	2	75	1
Chaya	48	2	42	2.5	69	2
Orange	45	3	35	3	74	3
Habanero	39	4	37.5	4	44	4
Anona	33	1	31	1	37.5	1

While households hold a strong value for the role of lot-crops in providing additional food for the family, it is important to note that only 5 percent of non-grain farming

households cultivated some amount of grains in their home lot during the main planting season in 2012. In addition, and irrespective of household type, only 3 percent cultivated sweet potato, 19 percent okra, 11 percent taro, 11 percent cassava, and 6 percent squash; high yielding crops that are known to be of relatively low maintenance. In addition, only 11 percent of all village households cultivated more delicate vegetables, including tomato, spinach, cucumber, and sweet pepper. Thus, while 97 percent of all households cultivate tree crops, vegetable and root crop farming in village lots is much less common. As a potential result, only 30 percent of all households actively apply soil amendments in home gardens, such as chicken manure mixed with sawdust, synthetic fertilizers, and compost.

Trends in food production by non-grain households

Given increasing prices for food, non-grain households were asked if they were actively planting, or planning on planting, more food today than in the past for family consumption or sale. 50 percent of non-grain households expressed that they were planting or preparing to plant greater amounts of food for family consumption. This proportion increases to 69 percent when including those desiring to cultivate more food for the family. In an open-ended question, over half of non-grain households producing, preparing or desiring to produce, more food (n = 31) expressed interest in cultivating low input, low cost or climate/pest resistant crop varieties on home lots, such as yam, sweet potato, plantain, cassava, taro, squash, okra, jícama, chaya and callaloo, as well as low-maintenance fruit trees. There remains strong interest in expanding production of indigenous crops as they are considered to bear well without synthetic fertilizers, are more resistant to extreme weather, are more storable or produce year round, and require a less initial investment after which the

purchasing of seeds to continue production is not necessary (i.e. they are self-producing). For a third of participants, more delicate vegetables, such as tomato, cilantro, cucumber, cabbage, and sweet pepper, were noted as crops of economic value and desirable dietary additions to the family diet of rice and beans. To a lesser extent, the production of corn and beans was also noted[32].

While over two thirds of non-grain households in the village have an interest in improving their subsistence food capacity, 23 percent indicated that they were planting, or preparing to plant, more food to generate income in the market. Of those selling or preparing to market more of their food crops, low-maintenance and more storable root crops, delicate vegetables, as well as greater investment in grain and cattle by landed households, were noted. Of those not planting or preparing to produce for income, non-grain households noted general disinterest, the small size of the domestic market, price fluctuation, and the high cost of chemical inputs for vegetables as reasons for not doing so.

Production challenges for non-grain households

For all non-grain households with food crops present in their home lot (n = 46), 83 percent of households expressed facing productive challenges in home gardens. Perennial crop problems made up 84 percent of all responses, specifically, pests and soil and water related problems in coconut, taro, chaya, orange, and avocado, which reportedly resulted in poor growth, low yields and premature death.

[32] Non-grain households include landed households who were not producing grains in extra-lot lands in 2012. Some non-grain households indicating that they were producing, planning to produce, or interested in producing more food for consumption or the market were considering so on extra-lot landholdings.

Other production challenges for non-grain households are divided into landless families (n= 31) and those with extra-lot land holdings (n = 17). In regard to any specific constraints to improving productive capacity, 26 percent of landless households believed they had no real obstacle, did not comment, or were not interested in improving food production. For others, access to land (29%), cost of irrigation[33] (26%), cost of seed (19%), soil infertility (19%), the impact of animal and human pests (19%), vulnerability to drought and/or slow-draining soils (16%), lack of infrastructure (10%), cost of chemical inputs (6%), land tenure insecurity (3%), and lack of knowledge (3%) were noted (not mutually exclusive) [34].

For households with additional land assets, 23.5 percent indicated that they were not interested in improving household food production capacity or did not face any personal constraints. For others, production challenges were related to off-lot farming. These included cost of seed (41%), cost of chemical inputs (18%), storage and other infrastructure (12%), transportation (12%), access to machinery (12%), distance to land/suboptimal road conditions (12%), labor costs (6%), climate related risk (6%), unstable market prices (6%) and theft (6%) (not mutually exclusive) [35].

[33] This includes physical costs of water infrastructure, as some households have yet to connect to the village water system. It also indicates inconsistent water availability, as all village households lack consistent water supply throughout the day, which is regulated at the household-level using water catchments. Additionally, irrigation concerns are also tied to the uncertain rate of water use. As a decentralized management system, the local water board relies on water fees to maintain economic sustainability. There is currently a flat rate of BZD $7.00 per month for unregulated water use. As a result, the water board has struggled with its incapacity to invest in system maintenance, adding to concerns over availability, as well as costs of future water services (Antoline Cano, Chairman of the Santa Familia Water Board, personal communication, December 8, 2012).
[34] Proportions based on total number of landless households.
[35] Proportions based on total number of landed non-farming households.

Access to SA technologies

71 percent of non-grain households (n = 34) expressed interest in learning new ways to improve their productive capacity. Practices of interest include general yield-improving practices (38%), maintaining and enhancing soil fertility (23.5%), managing pests (20.5%), low input crop cultivation (20.5%), low chemical input practices (18%), and erosion control methods (3%) (not mutually exclusive). Out of those expressing interest, 80 percent indicated that they did not know where to access services related to low-input and low-cost agriculture.

5.5 On-farm food production

Crop types and farming practices

Grain farmers in Santa Familia Village cultivate grain and non-grain crops for both subsistence and commercial purposes. Corn types include storable white corn, for long-term family subsistence and sale, and hybrid corn for immediate consumption, animal feed, and sale. Beans include commercial red and black types, as well as local vine varieties, including i*x-pelón, ibe, pascua,* and *bolokch*é. A variety of non-grain crops are also cultivated (see Table 16). Cropping practices range from highly diversified crop production, where cultivars are intercropped or planted in adjacent sections, to non-mechanized and mechanized monocropping practices with some variety of crops planted on the edges of fields or rotated temporally with corn. All farms in this study depended on seasonal rains, with planting beginning in May to mid-June, for the main season (*La Cosecha*), and beginning again in September after the dry month of August (*Yaxk'in*).

Shifting cultivation was practiced by 69 percent of grain farmers (n = 11), while 37.5 percent (n = 6) cultivated permanent fields and 6 percent cultivated both. Total median area farmed was 3 *manzanas*[36], or approximately 6 acres, with milpa farms averaging 6 acres and permanent farms averaging 6.5 acres. Manual planting using a hand-made dibble stick (*macana*) was conducted by 82 percent of grain farmers. In terms of labor use, 62.5 percent relied on family labor. The majority, or 82 percent, of all farmer fields were located on flat and sloping fields located in the valley; other fields are higher in the mountains (see Figures 5 and 6). It is important to note that 75 percent of grain farmers indicated having *bajos*, or low-lying lands susceptible to waterlogging on at least part of their farm, with only 42 percent planting early during the *San* José to mitigate against the effects of heavy rainfall.

Figure 5: Swidden Farm near Upland Base *Commercially-oriented farmer growing peanuts (middle-ground) with local corn-squash intercrop (foreground) and plantain, taro and cassava (background). Farmer not a study participant.*

Figure 6: Swidden Farm in Upland Mountains *Subsistence-oriented farmer with distant landholdings clears a new area for local corn production at the top of a hill. Farmer not a study participant.*

[36] 1 *manzana* is equivalent to approximately 2 acres.

For all grain farmers, 37.5 percent relied on synthetic fertilizers to produce food, with a median of 87.5 pounds per acre[37]. Only 9 percent of milpa farmers added synthetic fertilizers to their fields in 2012, compared to 80 percent of permanent farmers. Beside the use of external inputs, farmers largely depend on burning and crop residues to maintain soil fertility. Average fallow length for shifting farms was 2.25 years after a median of 5 years cultivation. While 75 percent of farmers sampled rotated corn temporally with beans, bean fields were planted by *mecate*[38] and typically not equivalent in area. Only one farmer actively utilized a soil-amending cover crop (velvet bean) to restore field fertility. To suppress weeds, 87.5 percent of farmers relied on synthetic herbicides, with a median of 1 litre per acre. This includes 82 percent of all milpa farmers and all permanent farmers.

Survey data reveals that 75 percent of grain farmers produced local white corn (n = 12) during the main planting season in 2012, with a median farm size of 5 acres. Average total production was 31 *quintales*[39]. All households producing white corn saved a portion of the yield for household consumption, with a median of 12 months of family subsistence. 69 percent of farmers also cultivated less-storable hybrid varieties, with a median farm size was 4 acres. Average total production was 7 *quintales*[40]. 69 percent of grain-farmers produced beans during the 2011 and/or 2012 Yaxk'in season, with a median cropping area of .6 acres.

[37] Farmers do not necessarily spread out their fertilizer by acre based on total farm area, where less commercially oriented producers may use such inputs only on certain crops.
[38] One *mecate*, or "rope" is equivalent to 25 square yards.
[39] The unit of analysis for corn yields is 100 pounds of shelled corn. Local corn, however, is not typically de-grained until consumption or sale. While grain farmers estimated the amount of total shelled corn by *quintal* in this study, early corn harvesting by the farmer, extended family and neighbors make total yield calculations particularly difficult and only serve as an estimation.
[40] This number does not sufficiently capture the amount of corn consumed and sold fresh.

81 percent, of bean producer's sampled used part of the harvest for subsistence purposes, with a median of 12 months of provision. Average total production was 6 *quintales*. The large majority, or 93.75 percent of grain farmers, did not produce rice in 2012.

The local squash variety, known as *siquíl* or *pepitoria,* is a common corn intercrop, with 69 percent of grain farmers sampled cultivating squash in 2012 for home consumption and sale. Other non-grain crops found on farmer fields include taro (*macal*), cassava (*yuca*), sweet potato (*camote*), okra (*ocoro*), plantain (*platano*), banana (*gineo, blogó*), jícama, and sugar cane. Food crops, such as taro, continue to be commonplace in farmer fields, while okra and jícama are less frequently cultivated (see Table 19). Despite one farmer having up to 15 different crop varieties in his field, the median number of on-farm food crops for all grain farmers was 6 [41].

Table 16. Common On-Farm Food Crops

Food Type	Grain Farmers (%)	Median Number
Corn	100	--
Beans	69	--
Squashes	69	--
Taro	88	200
Cassava	50	37.5
Plantain	50	100
Bananas	31	20
Sweet Potato	50	--
Okra	25	--
Jícama	6	--

[41] This does not account for variety between species. This number also underestimates sugarcane, non-commercial numbers of local hot peppers, as well as fruit trees; as farmers did not necessarily view these cultivars as a managed food crops.

Rice	6	--
Sugarcane	--	--

The value of grain farming to food and livelihood security

Out of all grain farmers, 94 percent stated that farming provided their family with food. 62.5 percent indicated maintaining secure access to food in the face of deteriorating socio-economic conditions, specifically, was the reason they maintained a farm. This proportion rises to 83 percent when looking at white corn producers exclusively. As one farmer stated:

When you work you have money, but when you stop work you have nothing. When you have a farm you will have something even when you cannot work.

Other reasons households maintained family farms included the ability to be independently productive (37.5%), add nutritional diversity to the diet (37.5%), generate income (31%), have what parents and grandparents had (25%), set an example for children (12.5%), contribute to one's family and society (6%), maintain claim to land (6%), learn about the environment (6%), and feel at peace in the mountains *(el monte*) (6%) (not mutually exclusive). Despite only one third explicitly indicating income generation, 95 percent of farmers sold surplus grain in 2012, while 56 percent sold some amount of non-grain crops, averaging 24 percent of male householder income (see Table 20).

Table 17. Median On-Farm Annual Income by Crop Type

Farmer Type	Income Corn	Income Beans	Income All Grains	Non-Grain Crops	Total On-Farm Income
All Grain Farmers	450	2,700	600	1,500	1,355
Part Time	525	3, 112	450	1, 360	1,050
Full Time	380	2,640	860	2,000	1,732

Trends in local food production

Given food price inflation and rising retail value of grain, grain farmers were asked if they were actively planting, or planning on planting, more food today than in the past for both family consumption and sale. 81 percent of grain farmers indicated that they were planting, or preparing to plant, more food for family subsistence purposes. Crops described included corn and beans, as well as various low-input and environmentally tolerant root and vegetable crops, such as okra, cassava, sweet potato, taro, and plantain. Delicate vegetables, such as tomato, cabbage, and sweet peppers, as well as fruit trees and micro-livestock additions were also mentioned as crops of choice.

In Addition, 81 percent of grain farmers also indicated producing, or preparing to produce, more products for the market. 61.5 percent of farmers producing more for the market are doing so in corn. An array of other crops were indicated as being presently marketable, including pepitoria, beans, melon, and peanuts, along with more delicate vegetables, local chicken and pork. Corn producers are taking advantage of higher prices by selling more fresh corn to local villages, as well as planting more hybrid corn to purchasers

in Spanish Lookout (see Appendix H). Other farmers were producing more white corn to take advantage of direct marketing opportunities with Guatemalan purchasers en route to Spanish Lookout[42]. One participant highlighted the value of agriculture in meeting income needs when he stated:

In the past, our parents worked the land and cost [of living] was lower. Now costs are higher and we work for less money. Agriculture is an opportunity for better income and helps the family with food.

Production challenges for grain farmers

When asked if farming has become more difficult, less difficult, or the same compared to the past, 62.5 percent of grain farmers stated that agriculture in Belize has become more difficult ($Chi = 6.5$, $df = 2$, $p < .05$). When asked in an open-ended question about the specific challenges farmers faced to improving food production capacity, 94 percent of farmers noted constraints:

Half of all farmers stated that the cost of machinery limits grain production capacity. Machine costs are incurred through the rental service rate[43] as well as the manner in which

[42] Bel-Car, the agricultural exporter and importer of Spanish Lookout, has been supplying several truckloads (equivalent to one-half a container each, or 25,000lbs) of yellow and white corn per week to Guatemalan transporters since the height of the food price surge, with up 68 truckloads recorded in one week (Otto Friesen, proprietor of Bel-Car export and import company, Spanish Lookout, personal communication, August 13, 2013.)

[43] Transportation costs by private servicers have been recorded at BZD $5.00 per mile plus $10.00 per hour to the driver, as well as a flat $12.50 per mile rate. Plowing fees are BZD $150.00 per hour, disking at $100.00 per hour, automatic seeder at $50.00 per hour and harvester at $150.00 per hour, or 1.50-2.00 per *quintal* of corn and 5.00 per *quintal* of beans if harvesting high volumes. Drying fees are based on moisture content, but typically equivalent to a BZD $1.00-2.50 per 100lb sack of corn that is deducted from the total due upon payment. (Informant 5, commercial hybrid corn producer, personal communication September 10, 2012, Quality Feed and Reimer's Feed Mill, personal communication, November 29, 2012).

machine owners operate. Farmers explained that grain harvesters from Spanish Lookout will not commute to farmer fields until sufficient work is contracted in the area due to small farm size. In some cases, farmers end up preparing and harvesting their fields during the night as a result of machines not being available during the day. Delayed access to harvesters has led to crops being exposed to heavy rains, severely impacting yields. Even subsistence oriented farmers stated that relying on machine services from Spanish Lookout, such as rice cleaning, forced them to wait months since small volumes of grain are not threshed until larger orders are obtained. Many farmers explained that access to both machinery and other inputs, such as roads, fertilizer, seed, pesticides and small tools, radioed price communication, along with an alternate purchaser and storer of grain in the form of the Cayo Marketing Board, were all more accessible in the past when the government invested in the countryside[44].

Nearly one third, or 31 percent, of grain farmers stated that market price fluctuations were a problem, which resulted in low purchasing prices upon harvest. This problem was described as a result of market domination by a small number of high-volume purchasers in Spanish Lookout. Low producer prices were described as the result of both supply gluts during main harvesting months and limited profit capture by non-Mennonite producers when prices are higher. Both full and part-time farmers felt they received less than what Mennonite farmers received from the sale of their product to the community's feed mills and export company. In addition, feed mill purchasers are said to over-charge mestizo farmers for grain

[44] Today, the Belize Marketing and Development Corporation (BMDC) only exists as a purchaser of grain in the more remote district of Toledo (MAF 2003a). Public storage facilities in the Cayo district were privatized in the mid-1980's, where the only option available exists in Spanish Lookout at the price of 16.5-20BZ cents per 100lb sack per month, though limited storage capacity upon harvest and farmer's immediate cash needs often limit the viability of this option in securing more favorable prices (Quality Feed and Reimer's Feed Mill, personal communication, November 29, 2012; Personal Observation).

drying by overestimating moisture content, thereby reducing total payment. The export company, on the other hand, is described as offering some of the lowest prices for corn, especially white corn, which discourage farmers from selling for export[45]. Some farmers also stated that they have been unable to sell their entire surplus in Spanish Lookout if seasonal yields by the town's industrial farmers exceeds expected supply. Others expressed worry that new land clearings for corn in the area will lead to further domestic and international market capture by large-scale farmers resulting in less demand for grain from villages[46]. Cultural distinctions between small mestizo farmers and industrial Mennonite farmers have resulted in widespread sentiment that agribusinesses in Spanish Lookout discriminates ethnically against mestizo producers in the area.

Another 31 percent of farmers stated that a lack of financial investment capacity limited their ability to improve production on their land. Investing in external inputs, including seed and fertilizers, were understood as essential for improving and expanding farming activates (see Appendix I). Climate variability was also mentioned by nearly a third of grain farmers. Heavy and sporadic rainfall, as well as tropical depressions, have resulted in floods and long dry periods destroying crops and leave what remains to facing flood and drought-related diseases. This is especially the case for farmers planting near the river or in

[45] Mennonite farmers who capture higher market prices with Bel-Car do so based on future global prices. They achieve this through informal cooperation with the company where they obtain a base price with subsequent monthly premium payments throughout the year. Do to immediate cash needs, as well as negative experiences working with agribusiness, relatively low grain volumes and potential unfamiliarity with contract farming, local farmers have been unable to capture higher international prices through formal export outlets. (Otto Friesen, proprietor of Bel-Car export and import company, Spanish Lookout, on August 13, 2013, Personal Observation).

[46] Between 2010 and 2012, Mennonite farmers in Spanish Lookout have purchased a total of 21,000 additional acres of private and public lands for the production of yellow and white corn to feed new local and international demand (Kenton Plett, proprietor of Reimer's Feed Mill, Spanish Lookout Nov 29, 2012.)

bajos, In addition, a third of participants stated that pests in general are a challenge for improving production. These include weevils and larvae infestations, forest pests, such as the white-nosed coati (*pizóte*), wild boar (*queqeo*) and various bird species, as well as stray cattle and thieves. Poor road conditions for those producing closer to or inside the mountains (12.5%), limited arable land (12.5%), access to credit (12.5%), labor constraints (12.5%), and security of land tenure (6%), were also noted.

Access to SA technologies

Approximately 69 percent of farmers surveyed had an interest in gaining knowledge on crop improvement techniques. Out of those expressing interest, general crop improvement, soil amending practices, and low-input vegetable production were noted. Out of those households expressing interest, 73 percent indicated they did not know any outlets to acquire knowledge on low-cost and low-input practices. Out of those aware of possible information sources, Central Farm was most frequently noted, with 75 percent complaining that their services were delayed, inconsistent, and/or irrelevant to their needs. As one disillusioned farmer stated (paraphrased):

Central Farm [has services], but gas costs are high and they don't give you anything to eat, the education given is always delayed and full of things that we already know or don't make sense. Why are they telling us how to reap mangos if we don't have a mango farm or where to sell mangos? The extensionists don't know anything, they don't have real interest, and we take all the risk.

All households were asked if they were presently, or ever had been, a member of an agricultural organization and the reasons for doing so or not doing so. 20 percent of *all*

village participants indicated they had once been a member of a village cooperative. The survey did not capture any participants who are active members of the current Grains Legumes and Vegetables (GVL) cooperative due to its small membership size[47]. Among household types who did indicate past membership (n = 13), either with the current GVL cooperative or with an older cooperative, *all* described the cooperatives in a negative light. 85 percent of past members stressed that financial mismanagement among cooperative leaders resulted in losses for all members.

The GVL cooperative, which can be considered the initial cooperative founded in the mid 1980's and from which new versions evolved, was established through a foreign-funded grant that provided the village with machinery and inputs for commercial production of grains and other crops. Participants explained that through the initial grant the cooperative became productive as farmers shared collective machinery, stored and sold corn, beans, rice, and cohune oil for the market. With the organization being granted credit in the 1990's, however, cooperative leaders in collusion with a local government official from San Ignacio embezzled the funds, leaving members undercapitalized and indebted[48]. Out of those that belonged to the GVL cooperative (n = 11), 82 percent underscored leadership mismanagement and corruption as the reason why they are no longer involved with farmer organizations.

[47] In order to remain registered as an active cooperative, a minimum of 10 members must regularly meet and work together with collective agricultural objectives. There are currently just 10 members in the GVL cooperative, half of which are from Santa Familia, while the remainder farming and residing in other villages and towns, including 3 foreign-born European and North American currently residing in Belize.
[48] Confirmed by Hugo Miranda, Educational Cooperatives Officer, Belmopan, personal communication, October 31, 2012.

Since the GVL co-op still exists today in a new form, focusing on organic vegetable certification and the development of agro-eco tourism, participants expressed a sense of exclusion from the economic opportunities, equipment and technical services offered there. 38.5 percent of past members stated they felt actively excluded from cooperative participation. Farmers explained this as a result of being blamed for past financial problems or in a selfish attempt by others to reap more personal benefit from new funding sources[49]. Representatives of the cooperative leadership confirmed these sentiments by stressing that no former members from the original GVL cooperative were allowed to re-enter due to past corruption[50]. In addition, the current leadership stressed that only formal cooperative members were welcome to the agroecological workshops held at the cooperative building, even as workshop agronomists expressed attitudes to the contrary, expecting co-op leaders to draw larger audiences from local villages interested in sustainable farming methods[51]. Former members also expressed general disillusionment with formal organizing, with many emphasizing that it does not work and increases risk of indebtedness (36%), while others expressed strong concern over the current use of the co-op grain storage facility in the center of the village, currently being rented out to a private business (27%).

[49] In 2008, the GVL cooperative was awarded a USD $50,000 grant to support village food security through sustainable agriculture in the wake of a tropical depression that resulted in severe flooding of some agricultural lands.
[50] GVL Cooperative, Local members, personal communication, September 1, 2012.
[51] David Tzul, CATIE workshop representative, personal communication, September, 7, 2012.

CHAPTER 6: DISCUSSION AND RECOMMENDATIONS

Food and nutritional security is established when households have an accessible and stable supply of food from which nutritional benefits can be derived (WSFS 2009). Supply and access are not only contingent upon trade and household purchasing power, but are also mediated through direct food production and social networks (Maxwell and Smith 1992). From a sustainable livelihoods perspective, ensuring stability in access and utilization of safe and nutritious food is contingent upon successfully managing for risk (i.e. economic, ecological, political) in food systems[52]. This includes building resilience in local natural capital assets through inclusive knowledge production (i.e. participatory learning) and technological development (Frankenberger and Goldstein 1990, Thompson et al 2007, Frankenberger et al 2012). Positive outcomes from the production of sustainable agricultural systems include strengthened social capital and adaptive capacity, sustainable food and nutrition security, restored ecosystem services and biodiversity conservation (Pretty et al 2003, Johns and Sthapit 2004, Kremen and Miles 2012, Pretty et al 2006, Altieri 1999, Masset et al 2011, Heywood 2013).

Current economic trends, ecological volatility, and rising costs to consume and produce food pose major challenges for rural livelihood sustainability in Belize (NHDAC 2010, Mendoza and Machado 2009, SIB 2009b, FAO and GOB 2011a). Although conditions of poverty do not necessarily translate into increased environmental degradation (Carswell

[52] Political disturbances can affect access to food (e.g. inter-group warfare), where good governance and local food production can mitigate against distribution problems (Frankenberger et al 2012.).

1997, Forsyth et al 1998, Scherr 2000), households both below and near the poverty line can experience constraints to sustainable land use that impact food and livelihood security over the long-run (Frankenberger and Goldstein 1990, Wiebe 1994, Reardon and Vosti 1995). In order to enhance rural food and livelihood sustainability in Santa Familia, the ecological and economic constraints to production must be overcome through secure access to adaptable SA technologies, productive resources, markets and financial services in a manner that accounts for heterogeneity in farming systems and local food security priorities.

6.1 Non-Grain Producing Households

Improving home garden diversity for greater food and livelihood security

Although low levels of cultivated crops can reflect high engagement in the labor market to secure sufficient purchasing power for indirect food access (Gliessman 2006), the livelihood conditions of most households in Santa Familia do not reflect high levels of food and livelihood security. In terms of human capital, nearly two-thirds of non-farming householders have only a primary school level of education, limiting opportunities for high paying formal employment. Construction related work, general day labor, and wage work in the agricultural industry are key sources of income, with half of non-farming householders engaging in a secondary income activity. Despite this, nearly 40 percent of female householders generated additional income through formal and informal work and the majority do so out of necessity. Rural livelihood diversification has not translated into greater financial security as over three quarters of non-grain households are unable to save money, and one third have reduced meal sizes in recent years, with the large majority doing so more

today than any time in the past.

With rising food prices and overall increases in the cost of living being common reasons for reductions in meal size, home gardens offer unrealized potential for reducing risk and ensuring nutrition security. For example, only 19 percent of village households cultivate okra, 11 percent taro or cassava, 6 percent squash, and 3 percent sweet potato in their home lot. In addition, only 5 percent of non-grain households cultivate grains in home lots and less than 11 percent of all households cultivate more delicate vegetables requiring greater care and chemical inputs, such as tomato, cabbage, sweet peppers. Given high levels of human capital and financial asset constraints among non-grain householders, coupled with limited on-lot food crop diversity and low utilization levels of local leafy greens, interventions to support sustainable home garden intensification could help strengthen food and livelihood security.

Despite historical neglect by development agencies, home gardens continue to be forwarded as a key component to sustainable food security in developing countries (Niñez 1987, Marsh 1998, Montagnini 2006, Pulido et al 2008). Today, two thirds of non-grain households are plant or desire to plant more food to improve family subsistence levels, while 23 percent are doing so as a means of generating additional income[53]. The increasing value of household food production in western Belize provides opportunities to enhance sustainable and productive food systems. Following Robin Marsh's (1998) six indicators of successful home garden development, several dimensions to sustainable garden intensification can be

[53] Non-grain households include landed households who were not producing grains in extra-lot lands in 2012. Some non-grain households indicating that they were producing, planning to produce, or interested in producing more food for consumption or the market were considering so on extra-lot landholdings.

suggested for incorporation into the NFNSC framework and the MAFs agricultural development strategy.

Overcoming the multidimensional constraints to sustainable home garden development

Marsh (1998) emphasizes that successful home garden initiatives necessarily create space for local food production techniques and account for socioeconomic differences between households to ensure strategies are low-cost and contribute to livelihoods. In this way, garden development interventions become culturally acceptable as well as economically and ecologically sustainable over the long term. Where home gardens are less diverse in nature, Marsh (1998) posits that incorporating indigenous food crops and practices used by more traditional communities in the area can promote the adaptation of local and low-cost SA systems. Belize holds rich examples of traditional Mayan gardens that have aided in meeting family food needs for centuries (Levasseur and Olivier 2000). These include crops currently being produced in very low numbers on home lots in Santa Familia that are nonetheless valued for their level of storability, self-reproduction, yield, and/or resistance to pests and climate change (e.g. taro, cassava, squash, sweet potato). Promoting the regular cultivation of such foods in home lots, in addition to other low-input crops such as jicama (*Pachyrhizus erosus*) and yam (*Dioscorea spp)* could foster low-cost dietary diversity and improve local food systems. In addition, ensuring greater consumption of mineral rich chaya greens (*Cnidoscolus acontifolius*) and cultivation of edible wild species, such as *hierba mora* (*Solanum nigrum*), would provide high concentrations of vitamins and minerals lacking in a staple grains diet (Ross-Ibarra and Molina-Cruz 2002, Padulosi and Hoeschle-Zeledon 2004).

In considering low-input crops of high economic value, greater cultivation of native corn and bean varieties, along with vegetables, such as local tomato, could help reduce reliance on commercial garden seeds and generate alternative income (see Appendix G). The Caribbean Agricultural Research and Development Institute (CARDI), which acts as the primary R&D institute in Belize, should become more active in marketing the open pollinated grain varieties it has developed as this would provide lower-cost seed options to villagers. However, hybrid seed will continue to remain culturally important to local income and diets. Wood and Lenne (1997) argue that farmers indiscriminately manage a diverse portfolio of both traditional and hybrid crops for practical reasons, which may help sustain overall levels of agrobiodiversity, including indigenous varieties. Given the high cultural value for hybrid corn and commercial vegetables such as tomato, cabbage, and sweet peppers, ensuring the availability of quality commercial seed at the village level and at affordable prices, can improve access to necessary inputs and reduce the need to purchase vegetables when prices are high (see Appendix E). Nonetheless, providing an outlet for a diverse array of open-pollinated vegetable seed can reduce reliance on commercial inputs and public subsidies by strengthening local seed saving and exchange systems (Marsh 1998). By supporting the cultivation of a combination of both low-input indigenous crops and culturally valued commercial varieties, households can optimize dietary diversity, reap an array of surplus food that can be shared or sold when market prices are favorable, and conserve local plant genetic resources and cultural knowledge.

In addition to promoting the incorporation of low-cost and low-input cultivars, biophysical constraints must be addressed if households are to achieve sustainability (Marsh 1996). Both drought and heavy rains in the slow-draining soils of Santa Familia village

increase drought and flood-related disease risks and adversely affect crop yields. Reducing climate-related impacts will not only require greater utilization of well-adapted indigenous crops, but also the use of raised beds to improve drainage in rainy seasons and conserve water in dry seasons. Additionally, pests and disease can be better controlled through increased diversity and intercropping (Gliessman 2006). Low-cost organic home-made pesticides can further aid in mitigating the impact of pests and disease for particular crops, including perennials (Pretty 1995).

With only a third of households actively applying soil amendments in home lots, composting can also enhance and maintain soil fertility and structure. Composting of household and livestock waste improve the chemical and biological health of soil, which also enhances water infiltration and controls for pests (Gliessman 2006). Soil nitrogen can be maintained using local food crops jícama (*Pachyrhizus erosus*) and native beans, such as ibe (*Phaseolus lunatus*), which are nitrogen-fixers (Castellanos et al 1997, Deocundo and Boege 1998, Santos et al 2008) and maintain cultural value for local species. Phosphorous enhancing species, such as heliconia (*Heliconia* sp), could be incorporated into gardens, along with native nitrogen-fixing trees, such as madre cacao (*Gliricidia sepium*) and white popinac (*Leucaena glauca*) that also provide fuel wood and fodder (Tergas and Popence 1971, Dommergues 1987).

Improved infrastructure is essential to protect home gardens from other types of pests, such as livestock (Marsh 1998). Given that microlivestock in the village are typically free-range and wild animals frequently damage garden crops, fencing will be required. Fencing

microlivestock would also allow for the collection of animal manures for use in composting. Fences could be constructed using local materials and live fencing using nitrogen-fixing trees. Both male and female household members need to be involved to maintain infrastructure and gardens (Marsh 1998). The various construction, maintenance and functional needs of home gardens must be fully understood by all household members. Female household member, who tend to stay home during the weekday, will be particularly important to home garden cultivation and management. Limited size in many home lots and concerns over the amount of vegetation by some families also underscores the importance of incorporating different garden techniques into agricultural development services. This should include the adaptation of multistory covered structures, currently being promoted to commercial farmers, using local materials in order to reduce the impact of extreme weather, pests and disease on more delicate vegetables.

The degree to which external institutional support is lacking for such interventions is reflected by the large proportion (79.4 percent) of non-grain households interested in SA techniques that are currently unaware of formal outlets from which to receive support in low input and low cost agriculture. To compound the problem, few formal or informal producer networks are now available; the GVL cooperative is the only source for organized SA assistance. Marsh (1998) argues that widening the impact of home garden interventions requires programs within public institutions. This is currently the case in Belize where there are few relevant services to home gardens and services are fragmented.

While NGO-run school garden programs can promote food and nutrition security in local communities, it is unclear to what extent such programs in Belize have impacted

household garden systems. In some cases, such interventions have delegitimized local cultivation practices by marginalizing traditional methods and food choices and increased reliance on external inputs (Reeser 2013). Even in the rare case of targeted support by the MAF to individuals, Melissa Balán explains that small enterprise development policies have emphasized higher value crops, such as lettuce, cabbage, and broccoli, over local varieties in order to maximize returns to investment and secure long-term economic sustainability[54]. In this vein, organic production methods have been encouraged under the framework of reducing commercial costs that adds market value. Such market-oriented approaches, while beneficial to some families, do not incorporate storable crop varieties that are important in maintaining food security as well as income generation. While government officials are aware of challenges to economically sustainable agricultural interventions[55], no systemic strategies have been forwarded to address both subsistence and commercially oriented producers and their different economic and food security needs and interests.

Sustainably enhancing local home gardening necessarily requires long-term public investments that create space for local crop and knowledge systems (Marsh 1998). Geographically targeted agricultural assistance, whether school or household oriented, limits the overall scope of outreach, which is not appropriate for a nation experiencing high levels of poverty throughout the country. An expanded national extension service with a fully integrated micro-agricultural component could potentially assist a wider array of household cultivators by providing more relevant technological and economic support (Marsh 1998).

[54] Melissa Balán, Extension Officer, Garden Coordinator, Ministry of Natural Resources and the Environment, Central Farm, personal communication, November 2012.
[55] Mario Howe, Extension Officer I, District Agricultural Coordinator, Ministry of Natural Resources and Agriculture, Central Farm, personal communication, November 20, 2012.

This will require investment to improve the human resource capacity within MAF to meet the needs and aspirations of local households.

A household to household approach, which facilitates informal group development and collaboration, could also help build social capital and reinforce local food cultivation practices (Reeser 2013, Marquez and Schwartz 2008). For example, the MAF could support regular workshops and garden field schools at the village level, and collaboratively develop (i.e. MAF and village cultivators) illustrative manuals to encourage shared learning and skill building.

As Kuyvenhoven (2004) suggests, targeted subsidies must also be considered for certain inputs depending on the particular needs of local households. Targeted subsidies for inputs, including vegetable seed, domestically-produced organic fertilizers, tools, and small irrigation infrastructure could reduce investment risks among lower-income households. Despite MAF's rhetoric praising integrated agriculture as a mode to ensuring small food producers overcome the economic and ecological constraints to production while safeguarding food security priorities (MAF 2008), the majority of small scale producers, including home gardeners, are not being reached through formal outlets. A systemic approach that integrates a home garden program into the MAF, and actively fosters collaboration with local NGOs and producer groups, can better ensure micro-agricultural services achieve food security and SA development goals.

Strengthening the role of creative marketing to shape local food consumption choices is a critical complementary initiative (Marsh 1998). In Santa Familia, low cultivation of herbaceous and shrub strata crops in home gardens and limited utilization of mineral-rich leafy greens reflects how processes of cultural change have affected land use practices and food consumption choices over time. Olga Stavrakis (1979) describes how imported goods have historically been given greater cultural value over local foods, thereby reducing the role of diversified home gardens to nutrition security. As a result, the status of rural woman, which was positively associated with their skills in managing complex gardens, has also declined (in Howard 2006). Yet, in Santa Familia, this process is not linear; under conditions of economic stress many households return to home gardening to improve both food and income security.

Richard Wilk (1999) points out that, today Belizean identity is globalizing in unique ways, creating space for the incorporation of both local and transnational values into family culture. As a result, traditional food practices, relegated by the colonial system, are being embraced in new ways that can positively reinforce local food values.

As such, outreach initiatives should utilize multi-media outlets to build upon new opportunities for sustainable home garden management. For example, the consumption of whole grains, fruits and vegetables could be linked to popular values, such as preventative health, youthfulness, weight loss, sustained energy and food preparation. In the process, education on the special characteristics of local crops, such as yield volumes, affordability, micronutrient contributions, and storability should be highlighted. Illustrative garden manuals that include dietary balanced recipes to encourage healthy transitions in food

preparation and consumption could be developed. Such efforts are indispensable for reinforcing healthy behaviors that maximize the utilization of garden foods among all members of the household.

6.2 Grain Farmers

Agroecological prototypes for Santa Familia Village

Diversification of livelihood strategies by small-scale grain farmers has not translated into high levels of food and livelihood security. With a median age of 54, grain farmers are older than most non-grain household heads and have a median of 6 children with an average of one additional household worker. With three quarters attaining only a primary school level of education, human capital is low and limits opportunity for high-skilled off-farm work. Over half of part-time farmers rely on sporadic day labor as a central off-farm income source, where they receive less pay compared to the primary livelihood strategy of non-grain households. Despite a third of households receiving domestic and foreign remittances, nearly two thirds of farmers sampled engaged in a second off-farm livelihood strategy. Overall, part-time farmers participate in the highest number of livelihood strategies compared to non-grain households. Nonetheless, 81 percent of householders are unable to save money. In addition, nearly 40 percent have had to reduce meal sizes in recent years, all of whom indicating having to do so more today than any time in the past. Financial constraints among both full and part-time farmers reveal the importance of low-cost, low-input SA technologies in both subsistence and commercially-oriented food practices.

With 62.5 percent of grain farmers indicating that agriculture in Belize has become more difficult, overcoming the multiple constraints to production in an economically and ecologically sustainable manner is critical. Greater utilization of SA technologies on small farms can not only help reduce reliance on external non-renewable inputs to reduce production costs, but would also improve soil health, control weeds, insects and disease, and increase ecosystem resilience that would help stabilize yields and reduce the effects of environmental shocks (Pretty 1995, Pretty et al 2006, Kremen and Miles 2012). Today, there is growing opportunity for promoting SA technologies in Santa Familia as 81.2 percent of grain farmers are actively planting more food for subsistence purposes, while an equal proportion are planting for domestic and international markets. Despite reliance on external inputs[56], yields are low, with milpa farmers averaging a mere 6.5 sacks of white corn and 1.5 sacks of hybrid corn per acre, while farmers cultivating permanent fields average 6 sacks of white corn and 10 sacks of hybrid corn per acre[57]. Bean yields for all farmer types based on the 2011 and 2012 Yaxk'in season is also low, at 6 100lb sacks reaped from a median of .6 acres. Low levels of production point to multiple biophysical constraints faced by village farmers in the village.

Farmers in Santa Familia note that heavy rains and floods, as well as droughts, have adversely impacted yields and resulted in increased pests and disease problems. Fedick and Ford (1991) point out that while the Upper Belize Valley is composed of relatively fertile

[56] It should be noted that external inputs use by village farmers is relatively low. Farmers average 87.5 pounds of complete fertilizer per acre, while recommended application is 165lbs per acre. In addition, farmers apply approximately 1 liter of herbicide per acre, while recommended application is 1.5 liters per acre (Store Manager, Midwest Steel & Agro Supplies, Novermber29, 2012).

[57] Open pollinated white corn can produce a maximum of 4000lbs per acre, while hybrid corn varieties produce up to 7000lbs per acre (Anil Sinha, agronomist, Caribbean Agricultural Research and Development Institute, Central Farm, personal communication, November 10, 2012).

land, the slow draining lowland soils composed of vertisols and mollisols create serious unpredictabilities for agriculture. Climate change projections for the area suggest further temperature increases and tropical storm intensities that may lead to shorter planting cycles and yield reductions due to increased weeds, pests and disease (Ramirez et al 2013, Richardson 2009). Adaptive capacity could potentially be strengthened by creating and maintaining drainage channels in flat valley lands and raised fields in river floodplains to protect crops from floods. Improved water management strategies could also extend cropping cycles, enhance fertility, reduce pests and downstream runoff, as well as increase soil moisture during the dry season (Sluyter 2004, Renard et al 2012, Gliessman 2006). Despite less intensive adaptations by some farmers based on early planting in *bajo* environments, support for more intensified wetland management could result in wider adoption and improve farming systems in riparian zones.

In addition to improved water management in lowland environments, small farmers could benefit from a greater understanding of the role of agrobiodiversity in managing soil health, weeds and pests, and in strengthening resistance against natural disasters. Continuous cropping without use of crop rotation and associations, crop residues, animal manures and/or mulches can deplete soil nutrients and lead to agroecosystem degradation (Gliessman 2006). The cultivation of hybrid corn is especially demanding on soil nutrient, particularly Nitrogen, necessitating proper soil management to sustain fertility over time (Lambert and Arnason 1982).

While three quarters of farmers in Santa Familia rotate corn crops with legumes, encouraging improved rotations with nitrogen-fixing crops, especially in areas devoted to

corn, could safeguard soil health and future production. Greater cultivation of beans during the Yaxk'in season, especially local varieties as well as other Nitrogen-fixing foods, such as jícama (*Pachyrhizus erosus*), could increase soil nutrient levels in grain farms, while preserving culturally valued crops important to local diets (Martinez-Romero 2003, Santos et al 2008, Castellanos et al 1997). Greater use of intercropping techniques in corn production systems could also aid in biomass production, pest control and yield output without substantial financial cost to farmers. Establishing complementary crop associations that are familiar to villagers and provide net-benefits to farmers are critical considerations (Gliessman 1985). For example, farmers in Santa Familia could benefit from experimental intercropping of corn, bean, and squash, as they important to local food security and have high market value. Research by CATIE found corn-bean-squash polycultures have an LER of 1.55 for corn-bean mixtures compared to pure stands, and 1.24 for corn-bean-squash mixtures[58] (Risch and Handsen 1982). Studies from southern Mexico found the same polyculture to have an LER of 1.73, with up to 10, 24 tons of biomass production per hectare compared to just 6.68 tons in a corn monoculture (Gliessman 1985). As a result of intercropping, the prevalence of pests in these associations were also reduced significantly (Altieri et al 1978, Risch 1981).

Agroforestry, in which woody trees and shrubs are incorporated with crops and animals, is another key technology that can help farmers improve economic and ecological efficiency. Greater incorporation of N-fixing trees within and around permanent field sites, including madre cacao (*Gliricidia sepium*), white popinac (*Leucaenia glauca*) and *Sesbania*

[58] The Land Equivalent Ratios (LER) is defined as the total land in hectares required under pure stands to give the total productivity of a crop equal to one ha of a mixture (Risch and Handsen 1982).

rostrata (for more waterlogged soils) could support corn-based systems by improving N-stock and enhancing nutrient cycling, thereby reducing reliance on fertilizers. In addition, agroforestry systems provide an alternative source of fuel wood and fodder that can reduce pressure on forest resources (Dommergues 1987). In a study by CATIE in Costa Rica, alley cropping *Gliricidia sepium* with corn doubled N mineralization compared to sole cropping after 7 years. Corn biomass and N content were also higher under alley cropping by 120% and 180%, respectively (Haggar et al 1993). However, competition for resources between leguminous trees and crops can negatively impact yields, highlighting the role of proper field design, tree selection and maintenance to reduce trade-offs (Kang 1993, Vandermeer 1998).

In regards to shifting agriculture, specifically, many interventions could potentially enhance the sustainability of current short fallow systems. Milpa fallow length in the Cayo district has shortened due to increased interests in permanent field cultivation and constrained access to land, which has led to deficiencies in soil nutrients, particularly phosphorous (Arnason et al 1982). In addition to soil nutrient depletion, corn yields decline sharply by the third year due to increased competition with weeds (Lambert and Arnason 1986). Successional woody species traditionally managed in the Cayo district can develop a full canopy after just 3 years to suppress milpa weeds, while holding 51% of N and 56 % of the K content found in a 45 year old hardwood forest (Brubacher et al 1989). However, continuous cropping, frequent use of herbicides, removal of shoots, and annual burning reduce C and P levels needed for regrowth, thereby inhibiting fallow succession (Brubacher et al 1989, Miyanishi and Kellman 1986). Despite suggestions to shorten cropping periods and extend fallows up to 17.9 years (Arnason et al 1980), alternative agroforestry techniques adapted to intensified short fallow systems should be considered for regenerating milpa fields (Thrupp

et al 1997, Garrity 2007, Padoch and Pinedo-Vasquez 2010). Short (i.e. 2.25 year) fallows after a median of 5 years cultivation in Santa Familia reflects modern milpa practices in neighboring countries (Sanchez 1998, Whittman and Johnson 2008, Lara Ponce et al 2012), and could benefit from low-cost slash-and-mulch, agroforestry, and cover cropping practices.

Slash-and-mulch agriculture, where fallow vegetation is slashed and left on the soil during cropping, is a neglected form of cultivation that was once common in pre-Columbian America (Thurston 1994). The Quesungual slash-and-mulch system native to Honduras is based on the selection of economically and culturally valued trees and shrubs that are maintained and pollarded in the dry season and left for wet-season cropping. The practice is common on slopes of 10-25%, where it provides permanent soil cover to reduce erosion, and increase water holding capacity for drier season planting (Hellin et al 1999, Ayarza et al 2010). As Miyanishi and Kellman (1986) suggest, reducing burning periods to encourage the regrowth of woody species is critical for weed suppression. This could enable hillside farmers in Belize to sustain and extend cropping periods, while also providing additional sources of fruits and timber resources. However, fertilizers are sometimes necessary in overcoming the yield differences resulting from shortened fallows (Kato et al 1999).

Deterioration of biomass accumulation and weed suppression in fallows could be counteracted through the incorporation of fast-growing nutrient-enhancing trees and green manures. Experiments from Brazil show the biomass contribution of *Acacia auriculiformis* to be 57 and 72%, depending on plant spacing in a 21month old improved fallow, reflecting biomass levels of a 7 year natural fallow with similar levels for N-stock accumulation. Manual or machine-propelled bush choppers are an important component of the system.

Particular economic benefits include weed suppression, reduced labor time, sustained and extended cropping, and increased production (Denich et al 2005). For farmers who can afford longer fallow periods, enriched fallows with fast growing indigenous timber species could be used. Studies from the humid lowlands of Costa Rica show rotation schemes using enriched fallows restored soil nitrogen and organic matter to levels of an adjacent 20 year old forest within 2.5 years. Not only were soil structure and nutrient stocks regenerated for grain cultivation, but in the process farmers gained economically from the sale of timber that generated higher net-returns compared to cattle-based agroforestry systems (Montagnini and Mendelsohn 1997). Phosphorous-enhancing species ideal for improved fallow management in Belize include (*Gynerium* sp) and *Piper amalago* (Lambert et al 1980). Furthermore, restoring the economic and ecological value of the Cohune palm in both permanent and swidden systems (*Orbignya cohune*) could contribute to N and P management and enhance soil structure in Belizean agroecosystems (Furley 1975, Arnason and Lambert 1982, Lambert and Gale 1984).

For farmers producing on steeper hillsides, cover crops may be a more viable technology for improving fallows. Velvet bean (*Mucuna pruriens*) are used by small farmers in northern Honduras, and a study there found inorganic N levels up to 100 kg ha^{-1} after 15 years of continuous rotation by slash-and-mulch cultivators (Buckles and Triomphe 1999). N rates never dropped below 25 to 50 kg ha^{-1} and fields maintained steady P levels. Not only were external fertilizer inputs avoided, but weeds and runoff, and increased SOM and water holding capacity were also achieved. As a result, corn yields were on average double those obtained without the legume, proving economically advantageous to farmers given

significantly greater returns to land and labor (Buckles and Triomphe 1999). Ecological and economic benefits, however, vary by local cropping patterns and seed varieties, with second season corn crops showing greatest benefits after sole cropping velvet bean during the first season (Eilitta et al 2003). As suggested by Eilitta et al 2003, the legume can function as a short-term fallow component and merits experimentation on small farms in western Belize, along with other cover crops with the potential to survive dry season conditions for synchronization with first-season maize.

In general, sustainable and diversified agricultural practices, including intercropping, agroforestry and cover cropping, reduce the impacts of extreme weather, including hurricanes and drought, while ensuring sustainable food output over the long-term (Holt-Giménez 2002, Lotter et al 2003, Kremen and Miles 2012). Many farming practices in Santa Familia are clearly adapted to local agroecological conditions, cultural traditions, and limited household resources, and could be built upon. This includes crop rotation, mixed and relay cropping, and early planting in *bajos*. However, intensified agroecosystem management can ensure the most efficient use of land and labor so that local investments in agriculture today prove effective in securing sustainable food and livelihood strategies into the future.

Policies for driving sustainable transitions in small farmer agriculture

The value of household food production in Santa Familia is multifunctional. Agriculture primarily functions to provide food to the family, especially to offset variability in wage income, consumer and producer food prices. With just over one third producing food as a means of generating income, varying degrees of crop commercialization also act as a

central, or alternative, livelihood strategy. Differences in median ages between grain and non-grain households reveal that when male householders age, work closer to home or exit the labor market, both of these factors become more important to supporting family needs. Agriculture also provides a dignified role to the aging householder through the provision of resources, and in society through the contribution of products for domestic and international consumers. For others, food production also plays a role in laying claims to land assets in the face of widespread tenure insecurity. With food security being a key objective for farming households, policies must go beyond market-oriented solutions for achieving sustainable food security and agricultural development so that all domestic farmers have secure access to the SA technologies, skills and productive resources necessary to drive SAI and sustainable rural livelihoods.

Developing a national participatory research and extension program

Intensified agroecosystem management requires secure access to a range of appropriate and sustainable technologies that build skills, knowledge and organizational capacity at the local level (Pretty 1995). Addressing existing imbalances in power relations that mediate access and utilization of technology and other resources is critical to this end (Pretty 1995, Frankenberger et al 2012, Thompson and Scoones 2009). In Santa Familia, access to appropriate technology is constrained by structural processes at many scales. Nearly three quarters of farmers interested in improving food production capacity are unaware of domestic outlets from which to receive information on low-cost and low-input practices. In addition, social capital is weak. Not only are farmers disillusioned with formal organizing, but the village cooperative has exclusionary policies that limit access to relevant

services. Discrimination in formal farmers organizations is not new, and is often tied to political patronage and cooptation through which benefits are gained (Moberg 1990, Belsky 1999).

Current food and agricultural policies are also discriminatory by narrowly focusing on market-based agricultural development strategies. For non-organized farmers in the Cayo district, national research and extension is largely contingent upon farmers attending trainings and workshops at the Central Farm research station where they are encouraged to develop the entrepreneurial capacity to manage a self-sustaining enterprise. With new emphasis on value chain development and organic niche markets, however, many grain farmers aware of such services express frustration that trainings are neither relevant to local needs nor cost-sensitive. MAF officials describe the practical challenges to maximizing impact as rooted in limited staff numbers[59] and low levels of expertise, in addition to a lack of organized transportation to ensure attendance at central research stations[60]. MAF officials also acknowledge the challenge and failures of encouraging commercially-oriented ventures among risk-prone farmers, yet remain convinced that the problem lies in the underdeveloped mindset of the farmer who fails to take advantage of existing market opportunities. For the government, overcoming this dilemma is dependent upon forming FOs and training leaders in business development[61]. Yet, the tendency to support farmers with sufficient financial

[59] There are a total of 7 extension agents for the district of Cayo.
[60] Robert Harrison, Director of Extension, Central Farm, personal communication, 31 October 2012; Hugo Mendoza, Cooperative Educational Director, Central Farm, personal communication, 31 October 2012; Oscar Salazar, Department of Research and Development, Central, personal communication, 10 November 2012; Mario Howe, District Acting Coordinator, Central Farm, personal communication 20 November 2012. Gustavo Tush, Acting Director, Central Farm, personal communication, 10 November 2012.
[61] Robert Harrison, Director of Extension, Central Farm, personal communication, 31 October 2012; Charles Bacab, National Coordinator for Food processing, personal communication, 20 November, 2012; Oscar Salazar, Department of Research and Development, Central Farm, personal communication, 10 November 2012;

capacity to ensure project success often conflicts with this mission[62]. Working within a market-oriented development paradigm, "demand-driven" farmer services are understood as a necessary condition for avoiding dependence on government services that discourage entrepreneurial thinking and individual responsibility.

For a developing country with high rates of rural poverty, current agricultural policies by formal institutions reinforce social inequities that marginalize the least capable to take advantage of existing services. In Belize, they also do little to ensure subsistence-oriented households overcome local socioeconomic and biophysical constraints and improve risk management strategies. Given that the majority of Belize's farmers have small landholdings and are not formally organized[63], national extension services should be expanded and capable of meeting the needs and aspirations of both full and part-time farmers, whether subsistence or commercially oriented in nature. Such a strategy, as stressed by Pretty (1995), requires institutional strengthening for wider farm system support shaped iteratively through dialogue with and participation from local people.

System-wide integration of participatory methods is critical. Participatory rural appraisal (PRA) can be described as "an approach and methods for learning about rural life and conditions from, with and by rural people" (Chambers 1992: 5). It requires that external actors take on facilitatory roles that enable rural people to exercise their own knowledge and analytical ability and express their needs and priorities through horizontal learning and communication (Chambers 1992). It also necessitates long-term programming where

[62] Oscar Salazar, Department of Research and Development, Central, personal communication, 10 November 2012

[63] Less than 20 percent of local cooperatives are active, functioning entities (IDB 2010, Hugo Mendoza, Cooperative Educational Director, Central Farm, personal communication, 31 October 2012).

outcomes are not interpreted through short-sighted economic measures alone, but on the development of inclusive networks that build capacity to investigate, think reflexively and resolve conflict, establish consensus and strengthen democratic local governance (Pretty 1995). However, participatory approaches have not always proven to be inclusive or representative of local needs, often giving marginal roles to farmers in implementation processes with little control over design and panning (Pretty 1995, Cooke and Kothari 2001).

Instead of being consumers of information and passive contributors during consultation, small farmers must be given real opportunity to participate in program planning and technological development that impact local socio-ecological systems (Pretty 1995). A participatory research and extension approach obliges external actors to work alongside local farmers by holding field schools outside of formal research stations (and formal cooperatives) where farmers can effectively participate in the design, experimentation, adaptation and dissemination of SA technologies (Pretty 1995, Buresh and Cooper 1999, Altieri and Nicholls 2008). It also requires that national extension agents have the multi-disciplinary skills necessary to facilitate the formation of informal groups between farmers with similar needs and technological interests. Once informal groups are strengthened, promoting knowledge exchanges through farmer-to-farmer extension programs can help scale out successful SA technologies, as demonstrated by the *Campesino a Campesino* movement in Central America (Holt-Giménez 2006).

Farmers must also be properly represented in cooperative meetings that involve social impact assessments to receive funding, in order to ensure outcomes from agricultural investments promote equitability at the village level. As Pretty (1995) notes, such outcomes require that village facilitators be well acquainted with farmers, aware of different production

systems and practices, and capable of generating and guiding discussions without dominating them. In this vein, creating space for organic social development and innovation without rushing into formal organization and complex objectives based on outside interests is imperative.

Thomason and Scoones (2009) argue that the path dependency of modern technological development in agriculture must be comprehensively restructured for optimal integration of new socio-technical systems. Milpa farmers must not be left out of this effort. Deterministic agricultural development models have historically reinforced policies to prohibit and transform shifting cultivation into high output monocultures. Decision makers, in equating modern agriculture solely with permanent intensive farming, overlook opportunities to learn from and improve important features of swidden systems (Thrupp et al 1997, Steinberg 1998). These include their value to local food and livelihood security (Altieri 1999, Belsky and Siebert 2003, Perreault 2005, Ibarra et al 2011), and biodiversity conservation (Padoch and Pinedo-Vasquez 2010). Shifting cultivators in Santa Familia not only produce food to manage risk, but demonstrate high commercial orientation not unlike permanent producers.

Currently, no policies exist to sustainably intensify short-fallow milpa agriculture in Belize[64], despite the fact that farmers continue to practice shifting cultivation as a practical means of securing food and earning a living (MAF 2003a). Without new institutional arrangements and policies to secure increased labor and resource use efficiency, wide-scale fallow management improvement will remain difficult to achieve (Place and Dewees 1999, Buresh and Cooper 1999). Technologies, such as intercropping, agroforestry and cover

[64] Fernando Tzib, NFNSC chair, personal communication, October 29, 2012.

cropping, are especially important in Central America where land concentration and land use change threaten the productive viability of swidden farms (Stonich 1995, Schwartz 1995, Arnason et al 1982, Van Vliet et al 2012). In Belize, food production by shifting cultivators has historically subsidized both the price of food to consumers as well as the low wages offered by agribusiness (Moberg 1991). Without access to appropriate SA technologies and greater inclusion in the sustainable development process, local ecosystems may become adversely affected by continued social marginalization.

Strengthening collaborative SA development initiatives

Sustainable food systems are those that are able to successfully "respond, cope with, and shape change" (Thompson et al 2007: 3). Unidisciplinary policies carried out by separate departments, government and non-government agencies weaken the scaling-out of participatory research and extension, upward communication, and the broader institutional support necessary to drive resilient agrolandscapes. Greater collaboration between government departments and between government and NGOs is needed to improve the impact and efficiency of small farmer services (Pretty 1995, Thompson et al 2007, Frankenberger et al 2012). While NGO's play a role in building local capacity that effectively responds to the needs and interests of the poor, they cannot replace the distributive role of nation-states as the representative of democracy in a globalizing economy (Kamat 2003). NGOs, like national policies, face crises of credibility when a focus on participatory learning, political empowerment, and structural reform is supplanted with predefined services and mere capacity building for free market engagement within the

paradigmatic confines of transnational financial and trade agreements (Kamat 2003, Holt-Giménez and Altieri 2013). NGOs nevertheless play critical roles in facilitating community-based NRM if long-term commitments allow for flexibility and effective scaling-out of SA initiatives in collaboration with public institutions. They can also play particularly important roles in holding public research and development accountable to local interests by serving as an intermediary between the micro and macro scales (Pretty 1995, Thrupp 2000, Medina 2010, Batta et al 2011).

In Belize, it is unclear as to what extent SA development initiatives by leading institutional players aim to move beyond market-led approaches to ensure inclusive capacity building for rural livelihood sustainability. In response to climate change and ongoing economic and social challenges, CATIE initiated the Mesoamerican Agro-environmental Program (MAP) that strengthens its institutional role in integrating research and driving sustainable development policy in the region. This has placed NGOs as leaders in collaborative and participatory approaches that, in partnership with the GoB and other operational and community-based organizations, aim to strengthen local governance for sustainable landscape management. The principle aim is to scale-out pilot projects and integrate FOs with local value chains, including ecosystem service certification schemes (CATIE 2009). In addition, the recent establishment of a national advisory committee aims to scale-up efforts by holding the GoB accountable through financial pledges and the development of a joint policy framework (CATIE 2011).

To date, limited effort has been made to facilitate local adoption and adaptation. Since 1998, mixed intercropping and improved short-fallow management techniques have

been recommended for the Cayo district (Avila 1998), yet projects today remain oriented towards fodder bank development to intensify livestock production and silvopastoral systems to combat climate change[65]. CATIE's in-country partner, the Inter-American Institute for Cooperation on Agriculture (IICA), has similarly oriented its mission to transform the agricultural sector into a competitive, diversified, and sustainable industry in line with the national priorities under the BRADS (IICA 2011). As such, there is little indication to what extent the scaling-out and scaling-up process under MAP will ensure participation by non-organized farmers or subsistence-oriented producers. It is important, therefore, that NGOs work with national extension agents to build human resource capacity, and that both service sectors work to reach a larger farming constituency.

In addition to creating inclusive participatory research and extension services, successful agroecosystem management requires system-wide interventions to reduce costs and risk for SAI. In the context of small-scale corn-based production systems in Belize, this necessitates interventions to secure access to productive resources, including land and other inputs, markets and financial services.

The Imperative of land reform

Rural poverty and land tenure insecurity create disincentives to SA development by undermining the security of value added land assets (Maxwell and Wiebe 1999, Lee 2005). In Belize, only 32 percent of farmland is owned with a title that can be transferred or used as collateral (WB 2009). In Santa Familia, only 10 percent of village households have a title or

[65] Muhammad Ibrahim, Agroforestry scientist, CATIE/IICA Belize, personal communication, 7 March 2014.

are in the process of obtaining title to their home lot, with less than half of all households lacking a formal lease contract. In addition, only 2.7 percent of households have secure property rights to extra-lot lands located in the Belize River Valley and the northern forested hillsides. Just over half of such landholdings are registered under formal leaseholds, while 40.5 percent have yet to be registered. Leaseholds do not represent secure tenureship, however, as they have been established specifically to optimize land development and can be retracted by the state for lack of payment or in the face of alternative economic opportunities (GOB 2003). Widespread land tenure insecurity is exacerbated by government corruption and increasing land speculation that pose serious threats to the natural capital assets of native Belizeans (Sutherland 1998, Iyo et al 2003). Low reading comprehension levels can further act to inhibit householders from pressing their land claims (Richards 1996). Compounded by land policies that encourage forest conversion to secure leasehold rights (Steinberg 1998, Clark 2000), such conditions undermine long-term investments in sustainable land use intensification.

Promoting greater equitability in outcomes from SAI requires formal recognition of local land rights. In the Cayo district where tenure insecurity is linked to leaseholds on public lands, this translates to private property rights. Expediting land registration in rural areas may require subsidizing surveying costs, reducing purchasing prices that are too high for low-income households, and progressive tax structures that reduce property tax burdens on low-income families. Such policies should be implemented based on longstanding claims prior to recent legislative reforms. Additionally, land clauses that encourage deforestation should be removed in an effort to reduce land conversion. Furthermore, making certain that village land lot sizes are sufficient for home garden production could ensure that non-farm households

have sufficient space to build subsistence food capacity.

Improving physical infrastructure

Road conditions are a concern for farmers in Santa Familia, highlighting the need for public investments to improve physical infrastructure. Roughly 80 percent of the country's road network is unpaved (IDB 2010), this includes major roads connecting the village to San Ignacio and Spanish Lookout[66]. Not only are paved roads in poor condition, but secondary road conditions vary throughout the year (IDB 2010). In addition, substandard, seasonally passable roads remain a major obstacle for farmers cultivating far from the village. These conditions, along with the cost of fuel, transport and spare parts, increase overall production costs. Public investments in rural infrastructure are essential for driving SAI (Kuyvenhoven 2004). It is therefore critical that the FAO and GoB follow through with commitments to improve infrastructural conditions in Belize if small farmers are going to have any capacity to participate in agricultural development.

Beyond liberalization: Market interventions for sustainable development

The role of markets in driving small farmer agricultural intensification is widely recognized, though debate exists over the correct set of policies appropriate for different country contexts (Reardon et al 1999, Place and Dewees 1999, Kuyvenhoven 2004, Lee 2005, Poulton et al 2009). Market development without consideration for the role political

[66] Personal Observation.

and economic forces play in shaping institutional arrangements that affect investment choices and development pathways can exacerbate social problems and lead to greater development challenges. New institutional approaches suggest that public policies cannot be founded on the simplistic assumption that competition will drive optimum economic development. New institutional economic theories run against neoclassical prejudices that predict greater liberalization in the agricultural sector – through research and extension, FO development, and improved infrastructure and credit alone – will lead to optimal levels of institutional and market development (Kydd and Dorward 2003). Dorward et al (2004b) shows that contrary to neoclassical assumptions, the retreat of coordinated service deliveries by the state after liberalization has resulted in higher transaction costs for small farmers in input, output, and financial markets that have led to market failure and underdevelopment traps in developing countries[67]. Exacerbated by low population densities[68], poor information systems, and a volatile ecological and economic environment, such conditions depress production incentives and increase dependency on imported staple foods (Dorward et al 2004a, Dorward et al 2004b, Kydd and Dorward 2003, Poulton et al 2009).

Agricultural trade policy advice to the GoB has emphasized market deregulation, limited public investments and accelerated export-oriented growth, be they traditional or non-traditional, within a liberal global market context (MAF 2003a, WTO 2010, FAO and GoB 2011a). Market liberalization has not only weakened the impact of public research and extension (Deep Ford and Rawlins 2007), but largely ended state intervention mechanisms,

[67] Cycles of grain scarcity and glut as a result of unstable prices depress production incentives for farmers and negatively impact net-food buyers. Private sector investments in service delivery vary by commodity system and tend to be strongest in traditional export crops (e.g., cotton, cocoa, coffee) (Poulton et al 2009).

[68] Belize's low population density has weakened agricultural production and market development (MAF 2003a,b). The population to forest ratio stands at 9.5 people km^2 (Chomitz and Gray 1996).

such as price floors to farmers, that can support economic development in rural areas (Moberg 1992). As a result of constrained farmer support services, consolidation of the grains market by large industrial farmers in Spanish Lookout has developed alongside increasingly weakened small farm productive capacity. Despite employment opportunities in agro-processing facilities, Moberg (1992) and Sutherland (1998) point out that wages remain suppressed, reinforcing the need for alternative food security strategies. As described by farmers in Santa Familia, as well as by national-level data (MAF 2003b, FAO and GoB 2011a), small farmers continue to face both high transaction and production costs[69] and risks[70]. Despite improvements in domestic food self-sufficiency and new comparative advantages in grain[71], contracted fiscal policies constrain small farmer participation in the sector, undermining opportunities for greater long-term growth through broad-based development.

Agriculture Demand-Led Industrialization (ADLI), on the other hand, highlights the comparative institutional advantage of the state in rural economies with weak markets, weak formal employment, high rural to urban population ratios and rapid population growth. Studies have shown that price stabilization policies targeting small producers can create net-

[69] Transaction costs can be described as those incurred to protect oneself against risk of transaction failure or costs incurred to meet specific requirement standards and by rent seeking behavior (Kydd and Dorward 2003). Transaction costs faced by small farmers in Belize include thin markets/market inefficiency; land tenure insecurity, and problems of access to credit. Production costs include the costs of mechanical technologies, fuel, seed, fertilizer and other inputs.

[70] Transaction risk can be described as the risk that a transaction arrangement will fail to secure the expected returns (Dorward et al 2004b). Transaction risks described by farmers in Santa Familia include coordination risks associated with cooperative mismanagement, seasonal price fluctuations, unreliable machinery services and risks of opportunism associated with pricing policies by a limited number of grain traders. Production risk, on the other hand, are associated climate change, soil depletion, pests and disease, and praedial larceny.

[71] The IDB (2010) confirms observations by participating farmers, as well as informants in Spanish Lookout, that corn produced in Belize is in many cases competitive in price, and especially in quality for the Central American market compared to US imports. This is especially the case for white corn, which is more culturally desirable for human consumption in the region.

benefits to economic growth by creating widely profitable domestic economies that drive both farm and sustained non-farm development in rural areas. Strategic import substitution along with key public investments - not only in research and extension, technological development, land reform, and infrastructure, but also to subsidize inputs, credit, and producer price supports – have been shown to generate greater demand-linkages in Less Developed and Middle Income Countries more effectively than unregulated export-led agricultural growth alone[72] (Adelman 1984, Kydd and Dorward 2004, Dorward et al 2004a, Morrison and Sarris 2007).

A comprehensive analysis by the FAO on the effects of agricultural liberalization on grain prices and producer incentives reveals that higher domestic prices alone do not increase investments in agriculture (FAO 2005). Dorward et al (2004a) explains that nearly all agricultural transformations in poor rural areas in the 20th century began with market protections and subsidies for cereal-based agricultural intensification with high elasticity of demand. Driving economic growth was contingent on market interventions to encourage widespread on-farm investment and labor-demanding technologies as opposed relying on a small number of producers with access to credit and markets. In this context, rapid technological development and inequitable distribution of returns by capital and import intensive ventures, undermine the sustained non-farm growth multiplier effects of a more comprehensive pro-poor investment strategy (Kydd and Dorward 2003, Deep Ford and Rawlins 2007). As Barham (1992) has argued in the context of Belize's citrus industry,

[72] Even if agriculture accounts for less than 50% of rural incomes, cumulative impacts on poverty reduction through reduced labor supply and increased grain volumes is significant (Dorward et al 2004b).

economy-wide liberalization efforts ironically constrain the economic gains associated with liberalization outcomes and lowers the likelihood of achieving them by inhibiting sectoral-level intervention. In this way, incomplete markets and imperfect information transform market "failures" into likely "market features" of the new economy (Barham 1992: 842). Pro-poor economic growth (PPAG) strategies, on the other hand, correct such conditions by lowering barriers for scarce human and financial capital, infrastructure and institutions, slowing distressed migration to urban areas that drive down wages for urban workers (Adelman 1984, Kydd and Dorward 2004).

A PPAG strategy, therefore, not only values the role of market protections from import-competing food goods in the early stages of economic development, but also necessitates comprehensive market interventions aimed primarily at reducing transaction costs and increasing economic returns to small-scale producers. The lack of effective policies to ensure the latter in Belize means that higher international grain prices today serve to fuel agricultural expansion by industrial farmers, further marginalizing rural households from the socioeconomic gains of staple crop production. Under current terms of trade, many farmers in Santa Familia must work off-farm to make a living, yet incomes are not steady enough to forgo farming altogether. Higher food prices in recent years have prompted over 80 percent of farming households to invest more in agricultural activities to improve their commercial food production capacity. The most pressing economic constraints faced by farmers in the village are a lack of affordable means to prepare and harvest fields, seasonal price fluctuations, and the cost of key inputs, such as seed and fertilizer. Compounded by other transaction and production costs and risks, such conditions create an unattractive market

environment for sustained investments for SAI. Resolving these constraints, therefore, necessitates stronger market coordination to secure wider access to input, output and finance markets in rural areas.

Subsidizing key SA inputs

Attention to the opportunity cost of labor and associated household incentive structures is important in determining the viability of labor-intensive SA technologies and in what ways labor-saving capital inputs affect overall labor market conditions (Lee 2005, Kuyvenhoven 2004). Given the relatively small size of the labor market in Belize, improving the supply of appropriate manual and animal propelled plowing and harvesting technologies, to increase labor productivity could encourage greater adoption of SA techniques. Because the price of machine inputs in Belize tends to be prohibitively high due to limited distribution and availability, as well as the cost of fuel, reducing input costs requires improved supplies as well as multiple service outlets that can promote competitive pricing. Ensuring the availability of simple mechanical options is necessary to maximize access to a wide range of energy-efficient SA innovations. Implementing targeted subsidies to households below and near the poverty line can further encourage adoption by the least financially secure.

Market concentration, by either public or private suppliers, can diminish competitive pressures for efficiency and result in disadvantageous prices to producers (Poulton et al 2009). The small commercial market for seed and fertilizer inputs in Belize keeps input prices high. In addition to promoting greater market competition among input traders, public institutions must play a more active role in ensuring access to alternative seed sources by

advertising and supplying lower-cost open-pollinated varieties developed through CARDI at the village level. Moreover, greater linkages with villages can better ensure field-based research plays an active role in informing external institutions on how native seeds can be better adapted to local biophysical realities. Maintaining low purchasing costs and storability traits should remain key priorities to cover the minimal needs of both subsistence and commercially oriented producers. Diversified grain-based systems also demand farmers be made more aware of improved indigenous crop varieties, including cassava, taro and high-value tropical fruits, currently being developed at Central Farm. Additionally, interventions to supply innovative household-level grain drying and storage systems are critical to strengthening physical infrastructure. The value of commercial vegetable production for many farmers also highlights the importance of ensuring availability of low-cost quality vegetable seed supplies along with appropriate local training in cultivation approaches (i.e. beyond cooperative centers). A subsidy targeted at both commercial and subsistence farmers near and below the poverty line for any additional farm and garden inputs, such as organic compost and pesticides, raw chicken manure, and small tools, can further reduce production costs and aid in promoting the domestic development of an SA input industry.

Price supports to low-income farmers

Producer price volatility reduces real income, slows the adoption and diffusion of technology, and undermines agricultural intensification (Kim et al 1992, Dorward et al 2004b, Kydd and Dorward 2003). Collective organizing can help strengthen bargaining power for price negotiation, but necessitates keen awareness of markets and analytical

capability. Furthermore, negotiating power is reduced by the presence of powerful buyers (Poulton et al 2009). High-volume grain purchasers and exporters in the Cayo district are limited to a small number of domestically-owned processors who fix prices based on seasonal needs with limited scope for farmer negotiation during downside price changes. Neils (1989) has observed these monopsonistic[73] relations in the district since the 1980's. In Santa Familia, price instability and limited purchasing outlets, especially for higher-value white corn, reduces household income, undermines on-farm investments, and keeps farmers reliant on hybrid seed. A comprehensive and transparent state intervention strategy could better encourage stronger market coordination for SAI compared to less-credible non-intervention policies.

The GoB could help boost the economic viability of individual grain farmers as well as domestic processors by engaging in a public-private partnership with a consortium of private traders charged with regulating downside price risks for white and yellow corn, and red and black beans. Instituting a minimum grain price guarantee well above the costs of production (including calculating for additional labor inputs) and within agreed upon price bands would secure a consistently profitable purchasing outlet for farmers in the country and improve grower-processor relations (see Neils 1989). As suggested by Poulton et al (2006), public costs could be efficiently invested by providing targeted price supports to lower-income producers, specifically. Complementing guaranteed price schemes with improved price communications infrastructure that reaches all producers, such as through radio and television, is suggested to encourage timely investments by the less poor. Surpluses could be

[73] Monopsonies are similar to monopolies (the latter being where the consumer faces uncompetitive high prices), except that it is the producer of the goods (or services) who is faced with suppressed purchasing prices (or wages). In agriculture, both monopsonistic and monopolistic relations can depress returns below his or her break-even point, thereby increasing risks of opportunism (Dorward et al 2004b).

supplied domestically to strengthen emergency preparedness systems, as well as supplied to "fair price" stores to ensure the food security of poor consumers (Poulton et al 2006). Given Belize's small domestic foods market, however, marketing activities undertaken by grain traders and the quasi-government marketing agency, Beltraide, must be strengthened to develop high-demand export market opportunities for primary and value added grains and other products produced by the country's small farmers. In this way, state-sponsored price supports would reinforce local food security strategies while maximizing incentives for SAI, in addition to generating greater foreign exchange and reducing the gap in economic disparities between small and large-scale farmers.

Affordable access to financial services

Reduced access to rural credit concentrates the capacity to engage in SAI among a small number of farmers, where the majority are left to extensify, intensify unsustainably, or exit the market (Reardon et al 1999). Underdeveloped financial markets continue to constrain farmers in Santa Familia and other parts of the country seeking affordable and flexible credit (FAO and GoB 2011a). Current borrowing rates by commercial banks for agriculture range between 15 to over 20 percent, with little allocated credit for higher-risk small farming enterprises[74] (IDB 2010). This highlights the importance of developing and expanding lower-cost informal financial institutions at the village level, but also linking them with formal credit institutions operating with public subsidies to secure sufficient financial flows (Poulton

[74] Half of total agricultural credit in Belize finances three large banana plantations, with an additional quarter financing large citrus growers, and 20 percent financing large sugarcane plantations. The remaining 5 percent is allocated to the poultry industry (IDB 2010).

et al 2009). As emphasized by the FAO and GoB (2011a) reorienting financial investments towards non-traditional crops and small farmers at low interest rates is critical, especially within the state-run Small Farmers Bank and local credit unions. Ensuring flexible repayment options are available within both public and private financial institutions is also important. Targeted subsidies for crop insurance are also a key consideration given the cost of premiums to financially strapped producers (IDB 2010). Without a substantial drop in transaction risks, improving access to credit can further harm farming households through unsustainable debt burdens.

Dis-incentivizing unsustainable agricultural practices

Landscape-scale agricultural activities can negatively impact socio-ecological resilience at smaller scales, requiring complementary state policies to reduce the expansion of conventional agricultural intensification (Pretty 1995, Lee 2005). Forests in Belize are valued both as a source of resources to maintain local livelihood security (Steinberg 1998, Levasseur and Olivier 2000, Zarger 2009), as well as a mode for biodiversity conservation and carbon sequestration[75] (Chomitz and Gray 1996, Cherrington et al 2010). Sustainable agricultural landscapes in the tropics not only function to reduce pressure on forests and enhance rural livelihoods (Pretty et al 2003), but they also play an increasingly pivotal role in *in situ* biodiversity conservation, habitat connectivity and matrix restoration (Heywood 2013, Vandermeer and Perfecto 2007, Scherr and McNeely 2008). In fact, many scholars argue that key features among intensified small and medium-scale producers, including their higher

[75] The population to forest ratio stands at 9.5 people per square kilometer, reflecting ratios in other important forest regions, including Bolivia (14.5), Congo (11.2), and the Brazilian states of Amazonas (1.3) and Pará (4.6) (Chomitz and Gray 1996).

productivity per unit area[76] and energy efficiency levels, make them particularly suited to be employed managing local landscape mosaics[77] (Perfecto and Vandermeer 2010, Altieri et al 2012, IAASTD 2009).

In Belize, agriculture is a key driver of deforestation (Chomitz and Gray 1996, Cherrington et al 2010). Agricultural expansion has historically been associated with resource concentration and increased social and ethnic inequality due to the types of policies used in promoting such development (Bolland and Shoman 1977, Moberg 1991, Moberg 1997). National land laws also drive deforestation as obtaining tenure security remains contingent upon forest conversion to prove development (Steinberg 1988, Clark 2000). The Cayo district today remains the most forested district in the country (Cherrington et al 2010). However, conventional agricultural expansion is a major cause of deforestation, which in the north has largely been driven by expansion in cattle and annual crop production (Chomitz and Gray 1996, Brown et al 2007). District level data for yellow and white corn show that the land area dedicated to non-mechanized shifting cultivation represents a small fraction of the land area under mechanized production[78] (GoB 2011). Mitigating the negative impacts of conventional agricultural expansion requires complementary policies that effectively dis-incentivize such practices. These should include stronger enforcement of environmental

[76] Interestingly, Barrett et al (2010) shows that the inverse productivity-size relationship is in part influenced by factor markets, where risk-averse farmers oversupply lower-cost labor to reduce exposure to consumer price fluctuations. Larger commercial oriented farmers, on the other hand, are less likely to over-supply labor in order to reduce the impact of fluctuations in producer prices. This poses new considerations within the debate.
[77] This premise of comparison itself is also disputed, as many scholars point out that the major agricultural problem is overproduction, which drives down producer prices for the world's poor -- the majority of which reside in, or are recent migrants from, rural areas (IAASTD 2009).
[78] In 2011, non-mechanized milpa farms represented only 5.3 percent of the acreage being produced under mechanized yellow corn, or 832 acres to 15,597 acres respectively. For white corn, which remains integral to household food security, non-mechanized milpa farms represented 36.4 percent of the acreage dedicated to mechanized white corn production, or 872 acres to 2,393 acres respectively (GoB 2011).

impact assessments (EIA), implementation of new regulations for large-scale commercial ventures, incremental taxation of non-renewable inputs and the eventual removal of tariff exemptions on imported conventional machinery.

Diversifying linear development approaches

While markets and particular subsidy regimes are key drivers of poverty reduction and wider agricultural intensification, the linear disposition of economic theories, including PPAG, highlight important gaps in thinking about agriculture and economic stability in developing countries. That is, like rural livelihoods, food systems are not indefinitely resilient, particularly in an era of global economic and environmental change. Building resilient food systems requires that SA be embedded within a dynamic policy framework that maximizes flexibility for adapting to surprises (Thompson et al 2007). Thompson et al (2007) argue that the PPAG narrative, in emphasizing the integration of small farms into higher-value commodity chains, sufficient-levels of non-farm rural growth, and the eventual liberalization of the sector to global market forces, fails to account for non-linear dynamics in socio-economic-environmental interactions. In Belize, these include the degree of farmer heterogeneity and the role that subsistence production plays in reducing risk for off-farm oriented households, the importance of accounting for traditional risk management strategies among small commercial farmers, and ecological and economic volatility associated with climate change and global market integration. Here, an agroecosystems approach that gives value to agriculture's multifunctional role in rural livelihoods and better accommodates for diversity, complexity and uncertainty in food systems can provide critical insight into managing for risk at different scales.

Rural communities are home to a diverse array of farmers, many of which may remain subsistence oriented even with new incentives to maximize income through commercial farm activities (Thompson et al 2007, Ellis 1998). Even amidst greater off-farm opportunities, it may be that such households continue to maintain traditional food security strategies to manage for risk (Ellis 1998). In Santa Familia, almost two thirds of grain farmers indicated risk management as a reason for farming, a proportion that increases to more than 80 percent when considering white corn producers exclusively. This data confirms national statistics showing food security priorities are of primary importance to farmers in the country (FAO and GoB 2011a). In addition to greater orientation in commercial activities, over 80 percent of grain farmers are today investing more time and resources into food production to improve their subsistence capacity. As such, food production, as well as forest resources, continue to play crucial roles in subsidizing off-farm work, as well as mitigating risk in commercial agriculture. Atypically, population growth in rural areas is rising faster than that in urban areas (WB 2010), increasing the likelihood that the utilization of land resources will remain vital to rural food and livelihood security into the future. A comprehensive food security and sustainable agricultural development strategy should thus aim to not only provide greater access to SA technologies and markets, but should also be structured in a way that maintains access to different inputs, incentives, and institutional arrangements over time.

Better incorporating these objectives into current food security and agricultural development policies reveal that much can be done to build resilience in local food systems that effectively promote the stated missions of the NFNSC and MAF. Incorporating a

subsistence-based program component within the MAF to sustainably enhance the farming practices of off-farm oriented households would allow subsistence farmers to access additional social services. This is important considering the fact that resource-conserving strategies require additional labor time to learn and implement new technological options (Pretty 1995, Renard et al 2012). These could include short-term payments to generate interest in unfamiliar technologies and to cover related transition costs to more sustainable production systems. As Pretty (1995) stresses, such incentives must provide net-benefits to farmer incomes to drive optimal levels of labor allocation. Such a program could also establish the basis for public and private payment schemes for agroecosystem services, providing additional incentives to maintain ecosystem integrity and biodiversity conservation that benefit society as a whole. Such "asset building" PES schemes could contribute to building resilient food security strategies while also improving livelihood diversification options for diverse households (van Noordwick et al 2007, Milder et al 2010).

In addition to maintaining targeted SA input subsidies to low-income producers generally, price supports to small commercial farms should be maintained despite growing economies of scale and non-farm diversification in rural areas. Maintaining price supports for low-income commercial farmers can be justified on the basis of promoting rural employment in diversified grain-based production systems that contribute to local food security and national self-sufficiency, as opposed to unsustainable livelihood diversification in times of economic downturn (Rosset 2006, Altieri and Nicholls 2008). This can be contrasted with conventional SA approaches that over-emphasize production in high-value non-traditional niche-market crops that do not necessarily ensure the food security priorities of farmers (see FAO and GoB 2011a). Dorward et al (2004b) also emphasize the importance of such

"livelihood protection and enhancement" mechanisms to protect local capital assets, including natural capital (619). While establishing minimum price guarantees falls under "Amber Box" supports discouraged within WTO rules (Deep Ford and Khaira 2007a), price supports to low-income producers could fall under Special and Differential Treatment clauses currently afforded to Belize[79].

Such support would also provide the economic basis for small-scale agrolandscape management, understood as a central means for achieving *in situ* biodiversity conservation, habitat connectivity and matrix restoration in the tropics (Altieri and Nicholls 2008, Heywood 2013, IAASTD 2009, Perfecto and Vandermeer 2010). This would aid in fulfilling new objectives under MAFs disaster risk management plan by ensuring labor is optimally allocated to resiliency-building initiatives in the countryside (see FAO and GoB 2011b). The less understood socio-cultural factors that influence risk averse behavior and limit investments in higher-value activities (Mendola 2007), adds further credibility to a food security and agricultural development strategy that preserves special institutional arrangements whereby small and medium-scale farmers remain a pillar of resilient staple grain production in the country.

[79] Article 6.2 within the AoA gives Special and Differential Treatment to developing countries, excluding from reduction commitments subsidies to low-income producers that contribute to rural development goals. *De minimis* exceptions allow trade distorting support up to 10% of the value of production for developing countries. Paragraph 25 of the Doha Work Program also states that state trading enterprises will receive special consideration in cases where it can facilitate agricultural transformation and help achieve food security priorities. (Deep Ford and Khaira 2007a). G33 nations are currently proposing that subsidies oriented towards low-income farmers and consumers be considered a "Green Box" measure, where spending would be unlimited. "Peace clauses" are being stressed during the interim in the case a developing country exceeds its "Amber Box" limits as a result of stockholding for food security (WTO 2013).

Sustaining diverse food system pathways at the national level is critical given the negative multiplier effects that agricultural trade policies can have on national food security, rural livelihoods, the environment and wider economic stability (Deep Ford and Rawlins 2007, Start 2001, Rosset 2006, Medina 2010, Holt-Giménez and Altieri 2013). As a small and vulnerable open economy with high food import dependency and limited foreign exchange, Belize is susceptible to the impacts of global food price surges and wider economic shocks[80] (Deep Ford and Rawlins 2007, Deep Ford and Khaira 2007b, Mendoza and Machado 2009). Natural disasters further destabilize the economy and seriously damage the agricultural sector (Ramirez et al 2013, Deep Ford and Khaira 2007b). Nonetheless, the country's relative land abundance continues to be marketed as a source of lucrative agro-export growth that can boost foreign exchange[81]. Despite growing skepticism of neoclassical growth models, transnational trade and financial institutions continue to push for laissez-fair policies in an attempt to eliminate disincentives to investment, enable specialization and production based on global comparative advantages, improve the competitive capacity of the entrepreneurial class, and reduce overall economic instability (WB 2009, WTO 2010, IDB 2010). Expansion in Belize's 'agro-export bundle' ranges from new FDIs in cacao and other exotic fruits, beef, marine products, as well as grains (IDB 2010: 126). Not only do economy-wide liberalization policies pose serious risks to rural livelihoods given the degree

[80] Most of the countries that did not receive the expected benefits of trade liberalization, and who's rural populations have become worse off, can be categorized as poor, small and vulnerable. In the Caribbean, market liberalization has led to substantial declines in absolute trade and well as shares in global trade (Deep Ford and Rawlins 2007). Common features among these countries are economic fragility, limited capital and technological assets, high external indebtedness, under-diversified markets, and low human capital development (Deep Ford and Khaira 2007b).

[81] The Caribbean Basin Initiative (CBI) established under the Reagan administration pioneered efforts for economic recovery during the 1980's financial crisis via unilateral and non-reciprocal duty free treatment of imports to the United States from the region. Export-oriented FDIs were argued as imperative for export diversification and economic growth, which were enabled in Belize through trade and processor tax exemptions, U.S. government-backed investment insurance and USAID infrastructural support to U.S. agri-food corporations (Barham 1992).

of land tenure insecurity, rural poverty and social marginalization, but it remains unclear how further restructuring will impact national food security priorities and efforts to build resilient multi-functional agro-landscapes.

As suggested by Deep Ford and Rawlins (2007), Belize as a SVE must be given sufficient space to develop a dynamic agricultural trade policy that achieves national and regional food security priorities and rural development goals (Deep Ford and Rawlins 2007). Such efforts must transcend the confines of Special Products and Safeguard Mechanisms in order to develop a comprehensive model for food sovereignty[82]. Since 1948, the government has aimed to ensure greater self-sufficiency in staple grains to feed its growing population (Moberg 1991). The NFNSC continues to uphold this principle in its mission to strengthen the country's "food security and sovereignty through sustainable and local production;" reinforcing the notion that staple foods are unlike other commodities in the market (NFNSC 2010: 10). Yet, it has increasingly done so through exploitative producer policies that serve to consolidate productive structures amongst capital-intensive farms. The principle of food sovereignty, however, goes beyond achieving national food self-sufficiency, as it centers on ensuring small farmers gain economically in the development of diversified staple food production[83] (Rosset 2006, Altieri and Nicholls 2008, Schanbacher 2010). It also underscores the imperative of equitable control over seed, water and forests, and highlights the role of

[82]G33 nations have argued for Special Products and Safeguard Mechanisms to mitigate against the negative effects of liberalization on national food security and rural livelihoods. Special Products are being negotiated that allow for maximum tariff flexibility to slow liberalization within the sector, increase capacity and competitiveness and reduce poverty. Special Safeguard Mechanisms for non-special products allow tariffs to be raised above bound rates when import prices fall or volumes rise above a certain level, thereby stabilizing domestic prices (Deep Ford and Khaira 2007a,b).

[83] Domestic and international supply management is a complementary measure within the Food Sovereignty framework that ensures prices cover the cost of sustainable production. Currently, world market prices are volatile and have no relation to production costs (Rosset 2006).

progressive land reform, including land size limits, to ensure pro-poor SA strategies[84] (Rosset 2006). A strong small farmer program within an integrated national food security and agricultural development strategy would fortify the role smaller producers play in contributing to national food security, thereby strengthening the mission of the NFNSC by mitigating for risk at both the local and national level.

Investing in small farmer agriculture

With 1.41 percent of expenditure allocated to the agricultural sector there are few signs that the GoB is ready or capable of driving comprehensive SA development that can ensure all food producers adapt to climate change and mitigate future economic stresses and shocks. National research and extension remains a shadow of what it was in the 1970's. Fiscal austerity, falling export prices and high debt service obligations continue to pose serious constraints to investment (Deep Ford and Rawlins 2007, NHDAC 2010). Increased dependency on transitory external funding further constrains long-term development planning and the ways in which development can be conceived. With poverty now spread geographically throughout the country, and disproportionately in rural areas, the importance of small farmer oriented R&D for sustainable agricultural development cannot be overstated. This has been emphasized among key researchers and authorities in the debate about future socio-technical trajectories in agriculture (IIED 2006, IAASTD 2009, Oliver deSchutter 2010, HLPE 2013).

[84] By the late 1980's, when land reform policies began to slow dramatically, 3 percent of landowners accounted for 90 percent of freehold land (Iyo et al 2003). While 26 percent of the rural population is landless, half of the land registered as farmland remains idle and concentrated among larger landowners (IDB 2010).

A thoroughgoing reform of MAF will be necessary to implement a sustainable food security and agricultural development strategy that can sustainably enhance the natural capital of small farmers. Funding must be substantially increased to improve governance structures, not only among FOs, but crucially at the national and district levels, so that the necessary research and management skills can be developed for scaling-up wider agroecological initiatives. This necessitates effective collaboration with non-government institutions as well as the private-sector, and must include enhanced systems for monitoring and evaluation at all scales. Such institutional strengthening, however, cannot coincide with conditional aid, lending and debt relief measures that reinforce political biases against the rural economy. Conditional development must be abolished if any attempt towards developing a resilient domestic food system is to be established. Importantly, good governance requires the political will to forward sectoral transformation, which, as Thompson and Scoones (2009) stress, necessitates an active break down of ideological barriers to real participatory alternatives.

The political-economic environment will largely determine the success or failure of SA development. This can result not only through misguided macroeconomic policy prescriptions, but also through political capture by rural elites causing misinvestment of already grim finances (Thompson et al 2007). Political hesitation may also be present, given that progressive decentralization and empowered participation can destabilize local political bases (Pretty 1995). The weak political and economic conditions of small farmers reduces their influence (Moberg 1990, Poulton et al 2009). Such circumstances highlight the critical

role national and transnational social movements play in pressing for deliberative and participatory democracy in countries with notorious historical records of political and ethnic exclusion. The coordinated action of farmers movements in alliance with civil society, such as *La Via Campesina*, can thus serve as a critical catalyst for change (Rosset 2006, Schanbacher 2010, Holt-Giménez and Altieri 2013). In this sense, while institutional restructuring is needed to enable dynamic, resilient and inclusive agricultural systems in the country, the agency for enabling greater dialogue and action must necessarily come from below as from above.

CHAPTER 7: CONCLUSION

This study set out to investigate the rural landscape of the Cayo district in Belize by conducting village-level research on the opportunities and constraints to sustainably enhancing household food and livelihood security. The aim of this research is to understand how local food systems can be made more ecologically and economically sustainable in order to build resilience against ecological and economic stresses and shocks. By conducting semi-structured interviews with households in Santa Familia Village, with government officials at the district and national level, participatory observation, and key informant interviews, the heterogeneity within rural livelihood systems, including farming systems themselves, was evident and suggests that multiple intervention pathways must be considered. Wider access to and utilization of sustainable agricultural technologies is a key necessity for enabling improvements in local food production. However, greater access to low-cost and low-input technologies alone will not enable sustained household investments for sustainable agricultural intensification (SAI). Reducing risk through secure access to productive resources, markets, and financial services in a manner that accounts for heterogeneity in farming systems and local food security priorities is also essential.

The state of livelihood assets among different household types allowed for deeper analysis into the ways multiple livelihood pathways could be strengthened through sustainable agriculture. For non-grain farming households, livelihood diversification in non-farm activities is important. Such households nonetheless continue to cultivate an array of food crops in their home lots as a response to higher food prices and increased living costs.

Livelihood strategies among non-grain households, however, have not produced sufficient financial security to avoid reductions in meal size by two-thirds of householders in the face of new economic stresses. Not only are human capital assets low, specifically low levels of formal education, but financial capital is insufficient. In addition, soil infertility, soil waterlogging, drought and pests, limit home garden cultivation opportunities and productivity.

The conditions of grain farmers are not substantially different, though, like many non-grain households, some farmers have achieved greater financial security through diversified livelihood strategies. Part-time farmers, who made up the majority of the farming sample, have the highest number of livelihood strategies, yet the majority remain financially constrained. This may be explained, in part, by the fact that part-time farmers are disproportionately engaged in day labor as their primary off-farm strategy, where wages are lower and work availability is variable. Despite high levels of self-sufficiency in corn, both full and part-time farmers lack the ability to save money and have had to reduce the size of meals in recent years. Natural capital constraints, in the form of vulnerabilities to waterlogging and drought, pests and disease, further undermine financial security among farmers. Soil nutrient losses and weeds resulting from unsustainable land intensification in both shifting and permanent cultivation, limit yields, income and sustainable agricultural intensification opportunities.

It is under such circumstances that weak social and institutional capital exacerbates unsustainable rural livelihood diversification in Belize. Mismanaged and exclusionary farmer cooperatives, a lack of alternative farming networks, and market-oriented agricultural

policies create unequal access to SA technologies and the institutional supports necessary to drive SAI in rural areas. Institutional policies that emphasize commercial FOs for access to organic input-output markets and financial services overlook the nature of social relations in rural society that shape unequal access to resources. Such policies achieve little for households with less interest in or capacity to increase commercial production and ignores the importance of food security among commercial as well as non-commercial farmers. Locked into market-oriented approaches forwarded by transnational financial and trade institutions, SA development policy in Belize reflect what Holt-Giménez and Altieri (2013) describe as reformist, "apolitical, technology-focused renderings of agroecology" (97). By failing to appreciate the variability of household assets and interests, current sustainable agricultural development policies are a disservice to rural people.

These circumstances underscore the importance of holistically addressing household food and livelihood security issues through small farmer participatory research and extension programs aimed at building resilience in a diverse array of household food systems. Wider access to SA technologies could potentially be secured by building multidisciplinary capacity among extensionists to facilitate participatory adaptation and diffusion of site-specific technologies for both subsistence and commercial farms, including home garden systems. A diverse array of options must be accessible to households given their particular biophysical and socioeconomic constraints, which in the case of Santa Familia, should include intensified water management strategies, slash-and-mulch technologies, grain-based intercropping and agroforestry techniques to increase and stabilize yields. While scaling-out and scaling-up of such initiatives necessarily requires greater involvement by the state, fostering decentralized

power relationships to ensure accountability necessitates collaborative institutional support by NGOs working at different scales.

Greater access to SA technologies alone, however, is insufficient for achieving SAI over the long-term. Increasing investments in SAI will also require secure access to productive resources, markets and financial services. Data from Santa Familia confirm national data on the severity of land tenure insecurity and the high production and transaction costs faced by farmers. Establishing secure land tenure arrangements and stable market access are essential to encourage farmers to invest in and reap the benefits of long-term SAI outcomes. Assuming appropriate biological and mechanical technologies are accessible and land resources are secure, a PPAG approach centered on reducing market constraints and entry costs for staple grain production could support SAI, poverty reduction and non-farm rural development.

Contrary to neoclassical approaches that push market-wide liberalization indiscriminate of a country's level of economic vulnerability, market protection of staple foods, price supports and access to financial resources could enhance food and livelihood security in areas where poverty is prevalent; without interfering with broader market, investment, and regulatory reforms. Such approaches underscore Kydd and Dorward's (2003) point that, in many developing states, it is not whether market interventions should be used, but *how* they are used. Thus, while the private sector within a free market environment is often considered the engine of growth, the state continues to play a pivotal role in ensuring that growth is competitive, sustainable and leads to wider development. In the words of Dani Rodrick (2001):

The main strike against existing trade rules is not that they overemphasize trade and growth at the expense of poverty alleviation, but that they overemphasize trade at the expense of poverty alleviation and growth. (4)

Alternative development approaches underscore the significance of questions raised by Thompson and Scoones (2009), particularly: "How inclusive and deliberative are the policy processes that define what agriculture is for – and who it is for?" (394). While PPAG cautions against accelerated liberalization and highlights the role of well-functioning agricultural markets in maximizing food and livelihood security, it is also critical to address its variable effects on household capacity to respond to risks associated with local-global food systems. Here, an agroecological approach better accommodates for complexity and uncertainty in socio-economic-environmental interactions by taking into account the multifunctional value of agriculture and forests to rural livelihoods and the risks posed by globally concentrated food production and distribution systems. National food security and agricultural development policies in Belize rhetorically aim to reduce the economic and social costs of future economic and ecological disasters by promoting resilient national food systems within a food sovereignty framework. Beyond the lack of a pro-poor agricultural growth strategy, little space has been created to accommodate for inherent heterogeneity in farming systems that can ensure relevant socio-ecological services to promote sustainable food security and agrolandscapes. Particularly important, currently unaddressed needs include institutional arrangements for off-farm oriented subsistence producers and economic supports for low-income grain-based commercial farmers.

The social and ecological imperatives of integrated food security and agricultural development strategies should add additional weight to economic considerations as an SVE for maintaining high national self-sufficiency in grains. Together, these factors point to levels of ineptitude within current transnational financial and trade arrangements, which must be addressed if nation-states are to achieve comprehensive food security and agricultural policies. Blunt policy instruments that lock Belize into static productive structures only serve to reinforce colonial growth models and exploitative labor relations in the country, instead of enabling competitive and sustainable food systems based on national-level needs, opportunities and constraints. The importance of institutional reforms at the national scale cannot be overstated, as higher rates of rural poverty, a growing rural population, and increasing investments in local food production necessitate collaborative and systemic SA interventions. These must also include complementary regulations to thwart large-scale forest conversion that impact the viability of sustainable small- and medium-scale farming systems. As Thompson and Scoones (2009) stress, comprehensive action to build dynamic and resilient food systems require a breakdown of paradigmatic framings, as "singular solutions are inherently implausible, and diverse options associated with different pathways […] are inevitable" (393). Despite a re-focus on national and transnational governance structures, the agency of local actors in pushing for greater deliberation over the policies that impact rural livelihood assets, capabilities, and opportunities remains an essential component within such processes, demanding continued support and solidarity in the struggle to achieve dignified and sustainable livelihoods.

REFERENCES

Adelman, Irma. 1984. "Beyond Export-led Growth." *World Development*, 12(9): 937-949.

Altieri, Miguel A., Francis C.A., Van Schoonhoven, A., and Jerry D. Doll.1978. "A Review of Insect Prevalence in Maize (Zea Maiz L.) and Bean (Phaseolus Vulgaris L.) Polycultural Systems." *Field Crop Research*, 1: 33-49.

Altieri, Miguel A. 1987. *Agroecology: The Scientific Basis of Alternative Agriculture*. Boulder, CO: Westview Press.

Altieri, Miguel A. 1999. "Applying Agroecology to Enhance the Productivity of Peasant Farming Systems in Latin America." *Environment, Development and Sustainability* 1: 197-217.

Altieri, Miguel A. and C.I. Nicholls. 2012. "Scaling Up Agroecological Approaches for Food Sovereignty in Latin America." *Development*, 51(4): 472-480.

Altieri, M. A., Funes-Monzote F.R. and Paulo Petersen. 2012. "Agroecologically Efficient Agricultural Systems for Smallholder Farmers: Contributions to Food Sovereignty." *Agron. Sustain. Dev*., 32: 1-13.

Alvarez, Yvette. 1988. "External Debt and Adjustment: The Case of Belize 1980-1986." *Social and Economic Studies*, 37(4): 39-56.

Alwang, J., Siegel, P.B., and S.L. Jorgensen. 2001. *Vulnerability: A View from Different Disciplines*. Social Protections Unit: World Bank.

Arnason, T, and J.D.H. Lambert. 1982. "Nitrogen Cycling in the Seasonally Dry Forest Zone of Belize, Central America." *Plant and Soil*. 67: 333-342.

Arnason, T, Lambert, J.D.H., Gale, J. Cal, J. and H. Vernon. 1982. "Decline of Soil Fertility due to Intensification of Land by Shifting Agriculturalists in Belize, Central America." *Agroecosystems*. 8:27-37.

Arnold M., Powell, B., Shanley, P., and T.C.H. Sunderland. 2011. "Forests, Biodiversity, and Food Security." *International Forestry Review*, 13(3): 259-274.

Avila, Marcelino.1998. "Agroforestry Opportunities for Belize." Pp. 7-13 in *Agroforestry Prototypes for Belize*, edited by M. Ibrahim and J. Beer. Turrialba, Costa Rica: CATIE

Ayarza, M., Huber-Sannwald, E., Herrick, J.E., Reynolds, J.F., Garcia-Barrios, L., Welchez, L.A., Lentes, P., Pavon, J., Morales, J., Alvarado, A., Pinedo, M., Baquera, N., Zelaya, S., Pineda, R., Amezquita, E., and Marco Trejo. 2010. "Changing Human-Ecological Relationships and Drivers using the Quesungal Agroforestry System in Western Honduras." *Renewable Agriculture and Food Systems*, 25(3): 219-227.

Barry, Tom. 1990. *Belize: A country guide*. Albuquerque, New Mexico: The Inter-Hemispheric Education Resource Center.

Batta, F., S. Brescia, P. Gubbels, B. Guri, J. B. Cantave, and S. Sherwood. 2011. "Transforming NGO Roles to Help Make Food Sovereignty a Reality." Pp. 93-114 in *Food Movements Unite! Strategies to Transform our Food Systems*, edited by E. Holt-Giménez, 93–114. Oakland, CA: Food First Books.

Barham, Bradford L. 1992. "Foreign Direct Investment in a Strategically Competitive Environment: Coca Cola, Belize, and the International Citrus Industry." *World Development*, 20(6): 841-857.

Barrett, C.B., Bellemare, M.F., and J.Y. Hou. 2010. "Reconsidering Conventional Explanations of the Inverse Productivity-Size Relationship." *World Development*, 38(1): 88-97.

Bebbington, Anthony. 1999. "Capitals and Capabilities: A Framework for Analyzing Peasant Viability, Rural Livelihoods, and Poverty." *World Development*, 27(12): 2021-2044.

Belsky, Jill M. 1999. "Misrepresenting Communities: The Politics of Community-Based Rural Ecostourism in Gales Point Manatee, Belize." *Rural Sociology*, 64(4): 641-666.

Belsky, Jill M. and Stephen F. Siebert. 2003. "Cultivating Cacao: Implications of Sun-Grown Cacao on Local Food Security and Environmental Sustainability." *Agriculture and Human Values*, 20: 277-285.

Bernard A, and O. Iyare. 2008. "Eradicating Poverty: The Illiberal Reality of Structural Adjustment Programs." Cave Hill, Barbados: University of the West Indies. Retrieved October 10, 2011 (http://www.psu.edu).

Bernstein, Richard H. and Robert W. Herdt.1977. "Towards and Understanding of Milpa Agriculture: The Belize Case." *Journal of Developing Areas*, 11(3): 373-392.

Belize Farm Registry. 2002. Ministry of Agriculture and Fisheries. Belmopan, Belize: Government of Belize Printing Office. Retrieved April 12, 2011 (http://www.agriculture.gov.bz/bfr/index.htm).

Belize National Meteorological Service (BNMS). 2013. *Belize Weather Summary 2012*. Retrieved March 2, 2013 (http://www.hydromet.gov.bz/yearly-weather-summary/176-2012-yearly-weather-summary).

Berkes, F., Folke, C., and M. Gadgil. 1995. "Traditional Ecological Knowledge, Biodiversity, Resilience and Sustainability." Pp. 281-299 in *Biodiversity Conservation*, edited by C.A. Perrings, K.G. Mäler, C. Folke, B.O. Jansson & C.S. Holling. Dordrecht: Kluwer Academic Publishers.

Bolland, Nigel O. 1977. *The Formation of a Colonial Society: Belize, from Conquest to Crown Colony*. Baltimore, Maryland: Johns Hopkins University Press.

Bolland, Nigel O. 2003. *Colonialism and Resistance in Belize*. Benque Viejo del Carmen, Belize: Cubola Productions.

Bolland, Nigel O., and Assad Shoman. 1977. *Land in Belize: 1765-1871*. Law and Society in the Caribbean No 6. The Institute of Social and Economic Research. Kingston, Jamaica: University of the West Indies.

Browder, J.O. 1994. "Surviving in Rondonia." *Studies in Comparative International Development.* 29(3): 45-69.

Brown, David and Kathrin Schreckenberg. 1998. *Shifting Cultivators as Agents of Deforestation: Assessing the Evidence*. ODI Natural Resource Perspectives, London, UK: Overseas Development Institute.

Brown, S., Hall, M., Andrasko, K., Ruiz, F., Marzoli, W., Gerrero, G., Masera, O., Dushku, A., Dejong, B., and Joseph Cornell. 2007. "Baseline for Land-Use Change in the Tropics: Application to Avoided Deforestation Projects. Lawrence Berkeley National Laboratory. Retrieved November 10, 2013 (http://escholarship.org/uc/item/0zd3j59j).

Brubacher, D.; Arnason J.T.; and J.D.H. Lambert. 1989. "Woody Species and Nutrient Accumulation during the Fallow Period of Milpa Farming in Belize, C.A." Plant and Soil, 114: 165-172.

Buckles, D. and B. Triomphe. 1999. "Adoption of Mucuna in the Farming Systems of Northern Honduras." *Agroforestry Systems*, 47: 67-91.

Cassman, K.G., 1999. "Ecological Intensification of Cereal Production Systems: Yield Potential, Soil Quality, and Precision Agriculture". *Proceedings of the National Academy of Sciences*. 96: 5952–5959.

Castellanos, J.Z., Zapata F., Badillo, V., Pena-Gabriales, J.J., Jensen, E.S., and E. Heredia-Garcia. 1997. "Symbiotic Nitrogen Fixation and Yield of *Pachyrhizus Erosus* (L.) Urban Cultivars and *Pachyrhizus Ahipa* (Wedd) Parodi Landraces as Affected by Flower Pruning." *Soil Biol. Biochem.*, 29(5/6): 973-981.

Central Bank of Belize (CBB). 2009. *Annual Report 2008*. Belmopan: Central Bank Printing Office. Retrieved October 14 2011 (https://www.centralbank.org.bz/publications-research/economic-publications/annual-reports).

Central Bank of Belize (CBB). 2010. *Annual Report 2010.* Belmopan: Central Bank Printing Office. (http://www.centralbank.org.bz/docs/rsh_4.2.4_annual-reports/central-bank-of-belize-annual-report-2010---full-document.pdf).

Chambers, Robert. 1992. "Rural Appraisal: Rapid, Relaxed, and Participatory." *IDS Discussion Paper 311*. Brighton, UK: IDS-University of Sussex. Retrieved December 18, 2012 (http://mobile.opendocs.ids.ac.uk/opendocs/).

Chambers, Robert. 1994. *Poverty and Livelihoods: Whose Reality Counts?* Institute of Development Studies (IDS). An Overview Paper prepared for the Stockholm Roundtable on Global Change, 22-24 July. Brighton, UK: IDS-University of Sussex. Retrieved August 2, 2012 (http://mobile.opendocs.ids.ac.uk/opendocs/).

Chambers, Robert, and Gordon G. Conway. 1991. "Sustainable Rural Livelihoods: Practical Concepts for the 21st Century." *IDS Discussion paper 296*, Brighton, UK: IDS-University of Sussex. Retrieved September 5, 2011 (http://mobile.opendocs.ids.ac.uk/opendocs/).

Chase, Arlen F. and James F. Garber. 2004. "The Archeology of the Belize Valley in Historical Perspective." Pp. 1-14 in *The Ancient Maya of the Belize Valley: Half a Century of Archaeological Research*, edited by James F. Garber. Gainesville: University Press of Florida.

Cherrington, E.A., Ek, E., Cho, P., Howell, B.F., Hernandez, B.E., Anderson, E.R., Flores A.F., Garcia, B.G., Sempris, E., and Daniel E. Irwin. 2010. "Forest Cover and Deforestation in Belize. 1980-2010." Technical Report. Retrieved April 16 2011 (http://eprints.eriub.org/1381/).

Chomitz, Kenneth M. and David A. Gray. 1996. "Roads, Land Use, and Deforestation: A Spatial Model Applied to Belize." *World Bank Economic Review*, 10(3): 487-512.

Clark, Charles. 2000. "State Leasehold and Mayan Customary Cultivation Rights in Belize." *Society and Natural Resources*, 13: 15-32.

Conklin, H.C. 1957. *Hanunoo Agriculture: A Report on an Integral System of Shifting Cultivation in the Philippines*. Rome: FAO.

Conway, Gordon R. 1987. "The Properties of Agroecosystems." *Agricultural Systems*, 24: 95-117.

Conway, Gordon R. and Edward B. Barbier. 1988. "After the Green Revolution: Sustainable and Equitable Agricultural Development." Futures, 20 (6), 651-670.

Cooke, B. and Uma Kothari. 2001. "The Case for Participation as Tyranny." Pp. 1-15 *in Participation: A New Tyranny?* Edited by B. Cooke and U. Kothari. London, UK: Zed Books Ltd

Corder, Gregory W. and Dale I. Foreman. 2009. *Nonparametric Statistics for Non-Statisticians: A Step-by-Step Approach*. Hoboken, NJ: John Wiley and Sons.

Deep Ford, J.R. and Gregg. 2007. "Trade Policy, Trade and Food Security in the Caribbean." Pp. 7-40 in *Agricultural Trade Policy and Food Security in the Carribean*: *Structural Issues, Multilateral Negotiations, and Competiveness*, edited by J.R. Deep Ford, C. dell'Aquilla, and Piero Conforti. Rome: FAO. Retrieved June 10 2011 (http://www.fao.org/docrep/010/a1146e/a1146e00.htm).

Deep Ford, J.R. and Handsdeep Khaira. 2007a. "Special Products: Developing Flexibility in the WTO Doha Round." Pp. 123-165 in *Agricultural Trade Policy and Food Security in the*

Carribean: *Structural Issues, Multilateral Negotiations, and Competiveness,* edited by J.R. Deep Ford, C. dell'Aquilla, and Piero Conforti. Rome: FAO. Retrieved June 10 2011 (http://www.fao.org/docrep/010/a1146e/a1146e00.htm).

Deep Ford, J.R. and Handsdeep Khaira. 2007b. "Caribbean Countries as Small and Vulnerable Economies." Pp. 41-71 in *Agricultural Trade Policy and Food Security in the Carribean*: *Structural Issues, Multilateral Negotiations, and Competiveness*, edited by J.R. Deep Ford, C. dell'Aquilla, and Piero Conforti. Rome: FAO. Retrieved June 10 2011 (http://www.fao.org/docrep/010/a1146e/a1146e00.htm).

Demeke, M., Pangrazio, G., and Materne Maetz. 2009. *Country Responses to the Food Security Crisis: Nature and Preliminary Implications of the Policies Pursued*. Agriculture Policy Support Service. Rome: FAO. Retreived June 15, 2011 (http://www.fao.org/fileadmin/user_upload/ISFP/pdf_for_site_Country_Response_to_the_Food_Security.pdf).

Denich, M., Vlek, P.L.G., de Abreu Sa, T.D., Vielhauer, K., and Wolfgang Lucke. 2005. "A Concept for the Development of Fire-Free Fallow Management in Eastern Amazon, Brazil." *Agriculture, Ecosystems, and Environment,* 110: 43-58.

Deocundo, Acopa and Eckart Boege. 1998. "The Mayan Forest in Campeche Mexico: Experiences in Forest Management at Calakmul." Pp. 81-98 in *Timber, Tourists, and Temples: Conservation and Development in the Maya forest of Belize, Guatemala and Mexico.* Washington, DC: Island Press.

Department for International Development (DFID). 1999. *Sustainable Livelihoods Guidance Sheets*. London, UK: DFID. Retrieved March 20, 2011 (http://www.dfid.gov.uk/).

DeSchutter, Oliver. 2010. *Report Submitted by the Rapporteur on the Right to Food*. Human Rights Council 16th Session. New York/Geneva: UN. Retrieved May 10, 2011 (http://www.ohchr.org*)*.

Dommergues, Y.R. 1987. "The Role of Biological Nitrogen Fixation in Agroforestry." Pp. 245-272 *in Agroforestry: A Decade of Development*, edited by H.A. Steppler and P.K.R. Nair. Nairobi: International Council for Research in Agroforestry.

Dorward, A, Poole N., Morrison, J., Kydd, J., and E. Urey. 2003. "Markets, Institutions, and Technology: Missing Links in Livelihoods Analysis." *Development Policy Review*, 21(3): 319-332.

Dorward, A., Kydd, J., Morrison, J. and Urey, I. 2004a. "A Policy Agenda for Pro-poor Agricultural Growth", *World Development*, 32(1): 73-89.

Dorward, A., Fan, S., Kydd, J., Lofgren, H., Morrison, J., Poulton, C., Rao, N., Smith, L., Tchale, H., Thorat, S., Urey, I., and Peter Wobst. 2004b. "Institutions and Policies for Pro-poor Agricultural Growth." *Development Policy Review*, 22(6) 611-622.

Eilitta, M., Sollenberger, L.E., Littell, R.C., and L.W. Harrington. 2003. "On-Farm Experiments

with Maize-Mucuna Systems in the los Tuxlas Region of Veracruz, Mexico. I. Mucuna Biomass and Maize Grain Field." *Expl Agric.*, 39: 5-17.

Ellis, Frank. 1998."Household Strategies and Rural Livelihood Diversification." *Journal of Development Studies*, 35(1): 1-38.

Ellis, Frank. 2000. "The Determinants of Rural Livelihood Diversification in Developing Countries." *Journal of Agricultural Economics*, 51(2): 289-302.

FAO. 1957. "Shifting Cultivation." Forestry and Forest Products Division. *Unasylva* 11(1): 9-11. Retrieved July 12, 2012 (http://www.fao.org/docrep/x5382e/x5382e00.htm#Contents).

FAO. 2000. *Global Forest Resource Assessment 2000*. Forestry Paper 140, Rome: FAO. Retrieved June 20 2012 (http://www.fao.org/docrep/004/y1997e/y1997e00.HTM).

FAO. 2005. "Trade and Food Security." Pg. 80- 97, in *The State of Food and Agriculture*. Rome: FAO. Retrieved October 3, 2011 (ftp://ftp.fao.org/docrep/fao/008/a0050e/a0050e_full.pdf).

FAO and GOB. 2011a. *Country Programming Framework for Belize: 2011-2015*. Ministry of Agriculture and Fisheries. Belmopan, Belize: Government of Belize Printing Office. Retrieved April 20, 2011 (ftp://ftp.fao.org/TC/CPF/Country%20NMTPF/Belize/status/CPFBelize20112015.pdf.)

FAO and GOB. 2011b. *Plan of Action for Disaster Risk Reduction.* Ministry of Agriculture and Fisheries. Belmopan, Belize: Government of Belize Printing Office. Retrieved June 2011 (http://*www.fao.org/climatechange/73869/en/*).

FAO. 2012. *The State of Food and Agriculture*. Rome: FAO. Retrieved July 12 2012 (http://*www.fao.org/docrep/017/i3028e/i3028e.pdf).*

FAO, WFP, and IFAD. 2012. *The State of Food Insecurity in the World 2012: Economic Growth is Necessary but Not Sufficient to Accelerate Reduction of Hunger and Malnutrition.* Rome: FAO (http://www.fao.org/docrep/013/i1683e/i1683e00.htm).

Fedick, Scott L. and Anabel Ford.1990. "The Prehistoric Agricultural Landscape of the Central Maya Lowlands: An Examination of Local Variability in a Regional Context." *World Archaeology* 22: 18–33.

Forsyth, T., Melissa L., and I. Scoones. 1998. *Poverty and the Environment: Priorities for Research and Policy.* Prepared for the United Nations Development Programme and the European Union. Brighton, UK: IDS-University of Sussex. Retrieved September 5 (http://eprints.lse.ac.uk/).

Frankenberger T.R. and D.M. Goldstein. 1990. "Food Security, Coping Strategies, and Environmental Degradation." *Arid Lands Newsletter*, 30: 21-22.

Frankenberger, T. R., Langworthy, M., Spangler, T., and Suzanne Nelson. 2012. *Enhancing Resilience to Food Security Shocks*. White Paper Draft, 23 May. TANGO International Inc.

Retrieved August 3, 2012 (http://www.fsnnetwork.org/sites/default/files/revised_resilience_paper_may_28.pdf).

Garrity, Dennis P. 2007. "Challenges for Research and Development for Improving Shifting Cultivation Systems." Pp. 3-7 in *Voices from the Forest*, edited by M. Cairns. Washington D.C.: Resources for the Future Press.

Geist, Helmut J. and Eric F. Lambin. 2002. "Proximate Causes of Underlying Driving Forces of Tropical Deforestation." *BioScience*, 52(2): 143-150.

Gliessman, Stephen R. 1985. "Multiple Cropping Systems: A Basis For Developing an Alternative Agriculture." NJ: Princeton University. Retrieved November 12, 2013 (https://www.princeton.edu/~ota/disk2/1985/8512/851207.PDF).

Gliessman, Stephen R. 2006. *Agroecology: The Ecology of Sustainable Food Systems*. Second Edition. Boca Raton, FL: CRC Press.

Grant, Cedric H. 1976. *The Making of Modern Belize: Politics, Society and British Colonialism in Central America*. London: Cambridge University Press.

GoB. 2003. *National Lands Act, Chapter 191*. Revised edition as of 31 May. Belmopan, Belize: Government of Belize. Retrieved July 2012 (http://faolex.fao.org/).

GoB. 2010. Belize Medium Term Development Strategy 2010-2013. Ministry of Economic Development, Commerce, Industry and Consumer Protection. Belmopan, Belize: Government of Belize Printing Office. Retrieved July 2011 (http://www.gov.bz/index.php/belize-medium-term-development.).

GoB. 2011. *Grains, Beans and Sugar Production: Cayo District*. Internal Spreadsheet. Ministry of Agriculture and Fisheries. Belmopan, Belize: Government of Belize Printing Office.

GoB and UNICEF. 2006. Belize Multiple Indicator Cluster Survey: Monitoring the Situation of Children and Women. Belmopan, Belize: Statistical Institute of Belize. Retrieved April 10, 2011 (http://www.statisticsbelize.org).

Grossman, Lawrence S. 1997. "Soil Conservation, Political Ecology, and Technological Change on Saint Vincent." *The Geographical Review*, 87(3): 353-374.

Haggar, J.P., Tanner, E.V.J., Beer, J.W., and D.C.L. Cass. 1993. "Nitrogen Dynamics of Tropical Agroforestry and Annual Cropping Systems." *Soil Biol. Biochem.*, 25(10): 1363-1378.

Haggblade, S., Hazell P.B.R., and Thomas Reardon. 2010."The Rural Non-farm Economy: Prospects for Growth and Poverty Reduction." *World Development*, 38(10): 1429-1441.

Hazell, Peter and Xinshen Diao. 2005. "The Role of Agriculture and Small Farms in Economic Development." Pp. 23-36 in *The Future of Small Farms*. Proceedings of a Research Workshop, June 26-29. *International Food Policy Research Institute and Overseas*

Development Institute. Longon, UK: Imperial College. Retrieved September 15, 2011 (http://www.ifpri.org).

Hellin, J., Welchez, L.A., and I. Cherrett. 1999. "The Quezungual System: An Indigenous Agroforestry System from Western Honduras." *Agroforestry Systems*, 46: 229-237.

Heywood, Vernon H. 2013. "Overview of Agricultural Biodiversity and its Contribution to Nutrition and Health." Pp. 35- 67. in *Diversifying Food and Diets: Using Agricultural Biodiversity to Improve Nutrition and Health*, edited by J. Fanzo, D. Hunter, T. Borelli, and Federico Mattei. New York, NY: Routledge.

High Level Panel of Experts (HLPE). 2013. *Investing in Smallholder Agriculture for Food Security: Report 6.* High Level Panel of Experts on Food Security and Nutrition. Committee on World Food Security. Rome: FAO. Retrieved October 2013 (http://www.fao.org/cfs/cfs-hlpe/reports/en/).

Holder, J.D. 2009. *Good DRM Practices for Belizean Small Farmers*. Ministry of Agriculture and Fisheries. Belmopan, Belize: Government of Belize Printing Office. Retrieved September 2, 2011 (http://www.fao.org).

Holt-Giménez, Eric. 2002. "Measuring Farmers' Agroecological Resistance after Hurricane Mitch in Nicaragua: A Case Study in Participatory, Sustainable Land Management Impact Monitoring." *Agriculture, Ecosystems & Environment* 93 (1-3):87-105.

Holt-Giménez, Eric. 2006. *Campesino a Campesino: Voices from Latin America's Farmer to Farmer Movement for Sustainable Agriculture*, Oakland, CA: Food First Books.

Holt-Giménez, Eric and Miguel A. Altieri. 2013. "Agroecology, Food Sovereignty, and the New Green Revolution." *Agroecology and Sustainable Food Systems*, 37: 90-102.

Howard P.L. 2006. "Gender and Social Dynamics in Swidden and Homegardens in Latin America." Pp 159- 182 in *Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry*, edited by B.M. Kumar and P.K.R. Nair. Advances in Agroforestry, Vol. 3. Dordrecht, Netherlands: Springer Publishing.

Ibarra, J.T., Barreau A., Del Campo, C., Camacho C.I., Martin, J.T., and S.R. McCandless. 2011. "When Formal and Market-based Conservation Mechanisms Disrupt Food Sovereignty, Impacts of Community Conservation and Payments for Environmental Services on an Indigenous Community of Oaxaca, Mexico." *International Forestry Review*, 13(3): 1-20.

Inter-American Institute for Cooperation on Agriculture (IICA). 2011. *IICA Technical Cooperation Strategy in Belize 2011-2014*. Belmopan, Belize: IICA. Retrieved January 5, 2014 (http://www.iica.int/Eng/regiones/central/belice/IICA%20Office%20Documents/Strategy2011-2014.pdf.).

International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD). 2009. *Agriculture at the Crossroads: A Synthesis of the Global and Sub-Global IAASTD Reports*. Washington, DC: Island press. Retrieved January 29 2011 (http://www.unep.org/dewa/assessments/ecosystems/iaastd/tabid/105853/default.aspx.).

International Development Bank (IDB). 2010. *Towards a Sustainable and Efficient State: The Development Agenda of Belize*, edited by D. Martin and O. Manzano. Washington, D.C.: IDB. Retrieved January 2014 (http://www.iadb.org).

International Monetary Fund (IMF). 2008. *Article IV Consultation*. Washington, D.C.: IMF. Retrieved November 2, 2012 (http://www.imf.org/external/pubs/ft/scr/2008/cr0888.pdf).

Iyo, J., Mendoza, P., Cardona, J., Casino, A., and Raymond Davis. 2003. *An Overview of Land Administration and Management in Belize* Belmopan. Belize: Government of Belize. Retrieved February 10, 2011 (http://www.terrainstitute.org/).

Johns, Thomas and Bhuwon R. Sthampit. 2004. "Biocultural Diversity in the Sustainability of Developing Country Food Systems." *Food and Nutrition Bulletin*, 25(2): 143-155.

Kamat, S. 2003. "NGOs and the New Democracy: The False Saviors of International Development." *Harvard International Review,* 25 (1): 65–69.

Kang, B.T. 1993. "Alley Cropping: Past Achievements and Future Directions." *Agroforestry Systems,* 23:141-155.

Kato, M.S.A., Kato, O.R., Denich, M., and P.L.G. Vlek. 1999. "Fire-Free Alternatives to Slash and Burn for Shifting Cultivation in the Eastern Amazon Region: The Role of Fertilizers." *Field Crop Research*, 62: 225-237.

Kellman, M.C. and C.D. Adams. 1970. "Milpa Weeds of the Cayo District, Belize (British Honduras)." *Canadian Geographer*. 14: 323-343.

Khan, Shahla, Julia Watkins, Judith C. Rodriguez, and Catherine Christie. 2009. "Health Implications of Food Patterns in Belize." *Topics in Clinical Nutrition*. 24(1): 73-81.

Khor, Martin. 2007. *The Importance of a Special Safeguard Mechanism in Agriculture at the WTO for Developing Countries*. UNDP Regional Trade Workshop: Doha and Beyond: Incorporating Human Development into Trade Negotiations, 17-18 December. Retrieved December 10, 2013 (http://www.twnside.org.sg/title2/par/paper.on.SSM.with.das.doc.).

Kim, T.K., Jayes D.J., and A. Hallam. 1992. "Technology Adoption Under Price Uncertainty." *Journal of Development Economics,* 38: 245-253.

Kleinman, P.J.A., Pimentel D., and R.B. Bryant.1995. "The Ecological Sustainability of Slash and Burn Agriculture." *Agriculture, Ecosystems, and the Environment*, 52: 235-249.

Kremen, C., and A. Miles. 2012. "Ecosystem Services in Biologically Diversified Versus Conventional Farming Systems: Benefits, Externalities, and Trade-offs." *Ecology and Society*,17 (4): 40.

Kuyvenhoven, Arie. 2004. "Creating an Enabling Environment: Policy Conditions for Less Favored Areas." *Food Policy*, 29: 407-429.

Kydd, J. and Andrew Dorward. 2004."Implications of Market and Coordination Failures for Rural Development in Least Developed Countries." *Journal of International Development*, 16(7): 951-970.

Lambert, J.D.H., Arnason, J.T. and J.L. Gale. 1980. "Leaf-litter and Changing Nutrient Levels in a Seasonally Dry Tropical Hardwood Forest, Belize, C.A." *Plant Soil*, 55: 429-443.

Lambert, J.D.H. and J.T. Arnason. 1982. "Nitrogen Distribution in Hybrid and Local Corn Varieties and its Possible Relationship to a Declining Soil Nitrogen Pool under Shifting Agriculture at Indian Church, Belize." *Pland and Soil*. 67: 119-127.

Lambert, J.D.H. and J.T. Arnason. 1986. "Nutrient Dynamics in Milpa Agriculture and the Role of Weeds in Initial Stages of Secondary Succession in Belize, C.A." *Plant and Soil*, 93: 303-322.

Lara Ponce E., Caso Barrera L., and Mario A. Fernández. 2012. "El Sistema Milpa Roza, Tumba y Quema de los Maya Itzá de San Andrés y San José del Petén, Guatemala." *Revista Ra Ximhai*, 8(2): 71-92.

Lee, David R. 2005. "Agricultural Sustainability and Technology Adoption: Issues and Policies for Developing Countries." *American Journal of Agricultural Economics*. 87(5): 1325-1334.

Levasseur, V. and A. Olivier. 2000. "The Farming System and Traditional Agroforestry Systems in the Mayan Community of San Jose, Belize." *Agroforestry Systems*, 49: 275-288.

Lok, Rossana. 1998. *Huertos Caseros Tradicionales* de *América Central: Características, Beneficios e Importancia, desde un Enfoque Multidisciplinario. Turrialba*, Costa Rica: CATIE. Retrieved July 20 (http://intranet.catie.ac.cr/intranet).

Lotter, D., R. Seidel, and W. Liebhardt. 2003. "The Performance of Organic and Conventional Cropping Systems in an Extreme Climate Year." *American Journal of Alternative Agriculture* 18(3):146-154.

Marsh, R. 1998. *Building on Traditional Gardening to Improve Household Food Security*. FAO Sustainable Development Department, Rural Institutions and Participation Service. Rome: FAO. Retrieved December 20, 2013 (http://www.fao.org/docrep/x0051t/x0051t02.htm).

Martinez-Romero, Esperanza. 2003. "Diversity of *Rhizobium-Phaseolus vulgaris* Symbiosis: Overview and Perspectives." *Plant and Soil*, 252: 11-23.

Marquez, A.R.C., and N. B. Schwartz. 2008. "Traditional Home Gardens of Petén, Guatemala: Resource Management, Food Security and Conservation." *Journal of Ethnobiology*, 28(2): 305-317.

Masset, E., Haddad, L., Cornelius, A., and J. Isaza-Castro. 2011. *A Systematic Review of Agricultural Interventions that Aim to Improve the Nutritional Health of Children*. London: EPPI-Centre, Social Science Research Unit, Institute of Education, University of London. Retrieved November 3, 2012

(http://r4d.dfid.gov.uk/PDF/Outputs/SystematicReviews/Masset_etal_agriculture_and_nutrition.pdf.).

Maxwell, Simon. 1996. "Food Security: A Post-Modern Perspective." *Food Policy*, 21(2): 155-170.

Maxwell, Simon and Marisol Smith. 1992. "Household Food Security: A Conceptual Review." Pp. 1-72 in *Household Food Security: Concepts, Indicators, and Measurement, A Technical Review*, edited by S.Maxwell and T. Frankenberger. Rome and New York: IFAD and UNICEF.

Maxwell D., and Keith Wiebe. 1999. "Land Tenure and Food Security: Exploring Dynamic Linkages." *Development and Change*. 30: 825-849.

Medina, Laurie K. 2010. "When Government Targets 'the State:' Transnational NGO Government and the State in Belize." *Political and Legal Anthropology Review*, 33(2): 245-263.

Meerman, J.C. and E.A. Cherrington. 2005. *Preliminary Survey of Land Degradation in Belize. United Nations Convention to Combat Desertification*. Ministry of Natural Resources, Local Government, and the Environment. Belmopan, Belize: Government of Belize Printing Office. Retrieved January 3, 2014 (http://biological-diversity.info/Land_degradation.htm).

Mendola, Mariapa. 2007. "Farm Household Production Theories: A Review of 'Institutional' and 'Behavioral' Responses." *Asian Development Review*, 24(1): 49-68.

Mendoza, Armando and Roberto Machado. 2009. *The Escalation in World Food Prices and its Implications for the Caribbean*. Caribbean Development Report, No. 2. Economic Commission for Latin America and the Caribbean. New York, N.Y.: United Nations. Retrieved February 25 (http://www.eclac.cl/publicaciones).

Mertz, O. 2002. "The Relationship Between Length of Fallow and Crop Yields in Shifting Cultivation: A Rethinking." *Agroforestry Systems*, 55: 149-159.

Milder, J.C., Scherr S.J., and Carina Bracer. 2010. "Trends and Future Potential of Payment for Ecosystem Services to Alleviate Rural Poverty in Developing Countries." *Ecology and Society*, 15(2): 1-19.

Ministry of Agriculture and Fisheries (MAF). 2012. "Our Vision, Mission, and Agricultural Policy". Government Website. Retrieved May 3, 2011 (http://www.agriculture.gov.bz/About_Us.html).

Ministry of Agriculture and Fisheries (MAF). 2003a. *The National Food and Agriculture Policy (2002-2020)*. Belmopan, Belize: Government of Belize Printing Office. (http://www.agriculture.gov.bz/PDF/Policy_Document.pdf).

Ministry of Agriculture and Fisheries (MAF). 2003b. Agricultural Development Management and Operational Strategy (ADMOS). Retrieved November 25, 2011 (http://www.agriculture.gov.bz/PDF/Agricultural_Development_Management_and_Operational_Strategy.pdf.).

Ministry of Agriculture and Fisheries (MAF). 2008. *Annual Report: 2008*. Belmopan, Belize: Government of Belize Printing Office. Retrieved August 10, 2011 (http://www.agriculture.gov.bz/PDF/Annual%20Report%202008.pdf.).

Ministry of Finance (MF). 2012a. *Historical Data on Fuel Prices*. Belmopan, Belize: Government of Belize Printing Office. Retrieved November 5, 2011 (http://mof.gov.bz/index.php/2012-08-30-03-42-02/2012-10-04-16-57-37/finish/6-control-of-fuel-pump-price/16-historical-data-regular).

Ministry of Finance (MF). 2012b. *Historical Data on Diesel Prices*. Belmopan, Belize: Government of Belize Printing Office. Retrieved November 5, 2011 http://mof.gov.bz/index.php/2012-08-30-03-42-02/2012-10-04-16-57-37/finish/6-control-of-fuel-pump-price/13-historical-data-diesel).

Miyanishi, Kiyoko and Martin Kellman. 1986. "The Role of Root Nutrient Reserves in Regrowth of Two Savanna Shrubs." *Can. J. Bot*., 64: 1244-1248.

Moberg, Mark.1990. "Class Resistance and Class Hegemony: From Conflict to Co-optation in the Citrus Industry of Belize." *Ethnology,* 29(3): 189-207.

Moberg, Mark.1991. "Marketing Policy and the Loss of Food Self-Sufficiency in Belize." *Human Organization*, 50(1): 16-25.

Moberg, Mark. 1992. "Structural Adjustment and Rural Development: Inferences from a Belizean Village." *Journal of Developing Areas.* 27(1): 1-20.

Moberg, Mark. 1997. *Myths of Ethnicity and Nation: Immigration, Work, and Identity in the Belize Banana Industry*. Knoxville, TN: The University of Tennessee Press.

Montagnini, Florencia. 2006. "Homegardens of Mesoamerica: Biodiversity, Food Security, and Nutrient Management." Pp. 61-84 in *Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry*, edited by B.M. Kumar and P.K.R. Nair. Advances in Agroforestry, Vol. 3. Dordrecht, Netherlands: Springer Publishing.

Montagnini, Florencia and Robert O. Mendelsohn. 1997. "Managing Forest Fallows: Improving the Economics of Swidden Agriculture." *Ambio*, 26(2): 118-123.

Morrison, Jamie and Alexander Sarris. 2007. "Determining the Appropriate Level of Import Protection Consistent with Agriculture Led Development in the Advancement of Poverty Reduction and Improved Food Security." Pp. 13-58 in *WTO Rules for Agriculture Compatible with Development*, edited by J. Morrison and A. Sarris. FAO Trade and Markets Division. Rome: FAO. Retrieved January 3, 2012 (http://www.fao.org/docrep/009/a0913e/a0913e00.htm.).

Myers, Norman. 1994. "Tropical Deforestation: Rates and Patterns." Pp. 27-40 in *The Causes of Tropical Deforestation: The Economic and Statistical Analysis of Factors Giving Rise to the Loss of Tropical Forests*, edited by K. Brown and D.W. Pearce. London, UK: UCL Press.

National Food and Nutrition Security Commission (NFNSC). 2010. *The National Food and Nutrition Security Policy of Belize*. Ministry of Agriculture and Fisheries. Belmopan, Belize: Government of Belize Printing Office.

National Human Development Advisory Committee (NHDAC). 2010. *2009 Country Poverty Assessment*. Ministry of Economic Development Commerce and Industry, and Consumer Protection. Belmopan, Belize: Government of Belize Printing Office. Retrieved March 10 (https://www.caribank.org/publications-and-resources/poverty-assessment-reports-2).

Neils, Kenneth. 1989. *How Price Stabilization Would Work in Belize*. Public Sector/Toledo Agricultural Marketing Project, Report No. 2. Manhattan, KS: Food and Feed Grains Institute, University of Kansas. Retrieved April 2, 2012 (http://pdf.usaid.gov/pdf_docs/PNABD639.pdf).

Netting, Robert. 1993. *Smallholders, Householders: Farm Families and the Ecology of Intensive, Sustainable Agriculture*. Stanford, CA: Stanford University Press.

Niñez, Vera. 1987. "Household Gardens: Theoretical and Policy Considerations." *Agricultural Systems*, 23: 167-186.

Nussbaum, Martha. 1992. "Human Functioning and Social Justice: In Defense of Aristotelian Essentialism." *Political Theory*. 20 (2): 202-246.

Padoch, Christine and Miguel Pinedo Vasquez. 2010. "Saving Slash and Burn to Save Biodiversity." *Biotropica*, 42(5): 550-552.

Padulosi, S. and I. Hoeschle-Zeledon. 2004. "*¿A qué Denominamos Especies Subutilizadas?" LEISA Revista de Agroecologia*. Retrieved January 10, 2014 (http://www.leisa-al.org/web/revista-leisa/83-vol20n1.html).

Palacio, Myrtle. 2000. *Food Security and the Poverty Paradox at the Local Level: The Case of North/South Belize.* Report from the Belize International Food and Nutrition Conference, Tuskegee University Alabama, October 8-10. Dangriga, Belize: Buyei Juan Lambey Institute.

Perfecto, Ivette and John Vandermeer. 2010. "The Agroecological Matrix as Alternative to the Land-Sparing/Agriculture Intensification Model." *PNAS*, 107(13): 5786–5791.

Perreault, Thomas. 2005. "Why Chacras (Swidden Gardens) Persist: Agrobiodiversity, Food Security, and Cultural Identity in the Ecuadorian Amazon." *Human Organization*, 64(4): 327-339.

Pimentel, D., McNair M., Buck L., Pimentel M., and J. Kamil. 1997."The Value of Forests to World Food Security." *Human Ecology*, 25: 91-120.

Place, F. and P. Dewees. 1999. "Policies and Incentives for the Adoption of Improved Fallows." *Agroforestry Systems*, 47: 323-343.

Pohl, M.D., Pope, K.O., Jones, J.G., Jacob, J., Piperno, D., de France, S., Lentz, D., Gifford, J., Danforth, M. and J. Josserand. 1996. "Early Agriculture in the Maya Lowlands." *Latin American Antiquity,* 7 (4): 355-372.

Poulton, C., Kydd, J., Wiggins, S., and A. Dorward. 2006. "State Intervention for Food Price Stabilization in Africa: Can it Work?" *Food Policy*, 31: 342-356.

Poulton, C., Dorward, A., and J. Kydd. 2009. "The Future of Small Farms: New Directions for Services, Institutions and Intermediation." *World Development*, 38(10): 1413-1428.

Pulido, M.T., Pargaza-Calderon, E.M., Martinez-Balleste, A., Maldonado-Almanza, B., Saynes, A., R.M. Pacheco. 2008. "Homegardens as an Alternative for Sustainability: Challenges and Perspectives in Latin America." *Current Topics in Ethnobotany*, 37: 1-25.

Pretty, Jules N. 1995. *Regenerating Agriculture: Policies and Practice for Sustainability and Self-Reliance*. Washington, D.C.: Joseph Henry Press.

Pretty J.N., Morison J.I.L., and R.E. Hine. 2003. "Reducing Food Poverty by Increasing Agricultural Sustainability in Developing Countries." *Agriculture, Ecosystems, and the Environment*, (95): 217-234.

Pretty J.N., Noble A.D., Bossio D., Dixon J., Hine R.E., Penning de Vries, F.W.T., and J.I.L. Morrison. 2006. "Resource Conserving Agriculture Increases Yields in Developing Countries." *Environmental Science and Technology*, 40(4): 1114-1119.

Ramirez D., Ordaz J.L., Mora J., Acosta A., and Braulio S. Hidalgo. 2013. *Belize: Effects of Climate Change on Agriculture.* Economic Commission for Latin America and the Caribbean. Mexico, D.F.: United Nations. Retrieved June 2013 (http://www.eclac.cl/publicaciones*)*.

Reardon, Thomas and Stephen A. Vosti. 1995. "Links Between Rural Poverty and the Environment in Developing Countries: Asset Categories and Investment Poverty." *World Development,* 23(9): 1495-1506.

Reardon, T., Barrett, C., Kelly, V., and K. Savadogo. 1999. "Policy Reforms and Sustainable Agricultural Intensification in Africa." *World Development Policy Review*, 17: 375-395.

Reeser, Douglas C. 2013. " 'They Don't Garden Here': NGO Constructions of Maya Gardening Practices in Belize." *Development in Practice*, 23(7): 799-810.

Richards, Michael. 1996. *Stabilizing the Amazon Frontier*. Natural Resource Perspectives. London, UK: Overseas Development Institute. Retrieved August 2, 2013 (http://www.mekonginfo.org)

Richardson, Robert B. 2009. *Belize and Climate Change: The Costs of Inaction.* Human Development Issues Paper. Belmopan, Belize: UNDP. Retrieved June 5, 2011 (http://www.bz.undp.org*)*.

Risch, Stephen J. 1981. "Insect Herbivore Abundance in Tropical Monocultures and Polycultures: An Experimental Test of two Hypotheses." *Ecology*, 62(5): 1325-1340.

Risch, Stephen J. and Michael K. Hansen. 1982. "Plant Growth, Flowering Phenologies, and Yields of Corn, Beans, and Squash Grown in Pure Stands and Mixtures in Costa Rica." *Journal of Applied Ecology, 19(3): 901-916.*

Robinson, G.M. and Furley P.A., eds. 1983. *Resources and Development in Belize: An Account of the University of Edinburgh Expedition to Central America in 1981*. Department of Geography, University of Edinburgh.

Rodrik, Dani. 2001. *The Global Governance of Trade: As if Development Really Mattered*. Social Development Group, Bureau of Development Policy. New York: UNDP. Retrieved November 3, 2011 (http://old.econ.ucdavis.edu/faculty/woo/Woo-Courses-UCD/Ecn%20270B/Papers/Rodrik-Trade%2520&%2520Development.pdf).

Roessingh, Carel and Amber Schoonderwoerd. 2005. "Traditional Farmers or Modern Businessmen? Religious Differentiation and Entrepreneurship in a Kleine Gemeinde Mennonite Community in Belize." *Journal of Developmental Entrepreneurship*, 10 (1): 65-77.

Rosset, Peter. 2006. *Food Is Different: Why the WTO Should Get Out of Agriculture*. London, U.K.: Zed Books Ld.

Ross-Ibarra, Jeffrey and Alvaro Molina-Cruz. 2002. "The Ethnobotany of Chaya (*Cnidoscolus Aconitifolius* Ssp. *Aconitifolius* Breckon): A Nutritious Maya Vegetable." *Economic Botany*, 56(4): 350-365.

Rubin, Allen and Earl R. Babbie. 2008. *Research Methods for Social Work.* Sixth Edition. Pacific Grove, CA: Thomson Brooks Cole.

Sanchez P. A., Palm C. A., Vosti S. A., Tomich T., and J. Kasyoki. 2005. "Alternatives to Slash and Burn: Challenges and Approaches of an International Consortium". Pp. 3-37 in *Slash-and-Burn Agriculture. The Search for Alternatives Palm*, edited by C. A., Vosti, S. A., Sanchez, P. A., and P.J. Ericksen, Columbia University Press, New York, pp. 3–37

Sanchez, Jose Luis P. 1998. "Organic Coffee Production and the Conservation of Natural Resources in Las Margaritas, Chiapas." Pp. 299-316 in *Timber, Tourists, and Temples: Conservation and Development in the Maya forest of Belize, Guatemala and Mexico.* Washington, DC: Island Press.

Santos, J.O., Araujo, A.S.F., Gomes, R.L.F., Lopes, A.C.A., and M.V.B. Figueiredo. 2008. "Rhizobia–*Phaseolus lunatus* Symbiosis: Importance and Diversity in Tropical Soils – A Review." *Dynamic Soil, Dynamic Plant,* 2(2): 56-60.

Schanbacher, Willaim. 2010. *The Politics of Food: The Global Conflict between Food Security and Food Sovereignty*. Santa Barbara, CA: Praeger

Scherr, Sara J. 2000. A Downward Spiral? Research Evidence on the Relationship Between Poverty and Natural Resource Degradation. *Food Policy*, 25: 479-498.

Scherr, Sara J. and Jeffrey A. McNeely. 2008. "Biodiversity Conservation and Agricultural Sustainability: Towards a New Paradigm of 'Ecoagriculture' Landscapes." *Phil. Trans. R. Soc*., 363: 477-494.

Schwartz, Norman B. 1995. "Colonization, Development, and Deforestation in Petén, Northern Guatemala." Pp. 101-132 in *The Social Causes of Environmental Destruction in Latin America*, edited by M. Painter and W.H. Durham. Ann Arbor, MI: University of Michigan Press.

Scoones, Ian.1998. "Sustainable Rural Livelihoods: A Framework for Analysis." *IDS Working Paper No. 72*. Brighton, UK: IDS-University of Sussex. Retrieved July 10, 2011 (http://mobile.opendocs.ids.ac.uk/opendocs/).

Scoones, Ian. 2009. "Livelihoods Perspectives and Rural Development." *Journal of Peasant Studies*, 36(1): 171-196.

Sen, Amartya.1981. *Poverty and Famines: An Essay on Entitlement and Deprivation*. New York: Oxford University Press.

Sen, Amartya.1984. "Rights and Capabilities." Pp. 307-324 in *Resources, Values and Development*, edited by A. Sen. Oxford, UK: Basil Blackwell

Shaw, John D. 2007. *World Food Security: A History Since 1945*. New York: Palgrave Inc.

Singh R.H., Rankine L.B., and G. Seepersad. 2005. A *Review of Agricultural Policies: Case Study of Belize*. The CARICOM Regional Transformation Programme for Agriculture. Trinidad: Department of Agricultural Economics and Extension, University of the West Indies. Retrieved September 2011 (http://www.caricom.org).

SIB. 2009a. *External Trade Statistics 2000-2008*. Belmopan, Belize: Statistical Institute of Belize. Retrieved September 5, 2011 (http://www.statisticsbelize.org.bz).

SIB. 2009b. *Annual Inflation Rates 1992-2008*. Belmopan, Belize: Statistical Institute of Belize. Retrieved March 10, 2011 (http://www.statisticsbelize.org.bz).

SIB. 2012. *Consumer Price Index: February 2011-2012*. Belmopan, Belize: Statistical Institute of Belize. Retrieved March 10, 2011 (http://www.statisticsbelize.org.bz).

Sluyter, Andrew. 2004. "Intensive Wetland Agriculture in Mesoamerica: Space, Time, and Form." *Annals of the Association of American Geographers*, 84(4): 557-584.

Stamoulis Kostas, and Alberto Zezza. 2003. "A Conceptual Framework for National Agricultural, Rural Development, and Food Security Strategies and Policies." *ESA Working Paper 03-17*, Rome: FAO. Retrieved October 10, 2011 (ftp://ftp.fao.org/docrep/fao/007/ae050e/ae050e00.pdf).

Steinberg, Michael K. 1998. "Political Ecology and Cultural Change: Impacts on Swidden-fallow Agroforestry Practices among the Mopan Maya of Southern Belize." *Professional Geographers.* 50(4): 407-417

Stonich, Susan C. 1995. "Development, Rural Impoverishment, and Environmental Destruction in Honduras." Pp. 63-100 in *The Social Causes of Environmental Destruction in Latin America*, edited by M. Painter and W.H. Durham. Ann Arbor, MI: University of Michigan Press.

Sutherland, Anna. 1998. *The Making of Belize: Globalization in the Margins*. Westport, CT: Bergen & Garvey.

Swaminathan, M.S. 2001. "Food Security and Sustainable Development." *Current Science*, 81(8): 948-954.

Tate, Phillip. 2013. *Integrating Housing and Population Census with Agricultural Censuses*. Presentation presented in the Port of Spain, Trinidad and Tobago, 10-12 June, 2013. Retrieved August 13, 2012 (http://www.fao.org/fileadmin/templates/ess/documents/meetings_and_workshops/IICA_2013/Linkages_TT_10-12June2013/Presentations/Belize_Agricultural_statistical_data_collection.pdf.).

Tergas, Luis E. and Hugh E. Popenoe. 1971. "Young Secondary Vegetation and Soil Interactions in Izabal, Guatemala." *Plant and Soil, 34: 675-690.*

Tilman, D., Cassman, K.G., Matson, P.A., Rosamond, N., and Stephen Polasky. 2002. "Agricultural Sustainability and Intensive Production Practices.*" Nature, 418: 671-677.*

Thompson J., Millstone E., Scoones I., Ely A., Marshall F., Shah E., Stagl S., Jasmine Wilkinson. 2007. "Agri-Food System Dynamics: Pathways to Sustainability in an Era of Uncertainty." *Institute of Development Studies, STEPS Working Paper No. 4*. Brighton, UK: IDS-University of Sussex Retrieved August 10, 2012 (http://mobile.opendocs.ids.ac.uk/opendocs).

Thompson, J. and Ian Scoones. 2009. "Addressing the Dynamics of Agri-food Systems: An Emerging Agenda for Social Science Research." *Environmental Science and Policy*, 12: 386-397.

Thrupp, L.A. 2000. "Linking Agricultural Biodiversity and Food Security: The Valuable Role of Agrobiodiversity for Sustainable Agriculture." *International Affairs*, 76(2): 265-281.

Thrupp, Lori Ann., Hecht, Susanna B., and John O. Browder. 1997. *The Diversity and Dynamics of Shifting Cultivation: Myths, Realities, and Policy Implications*. Washington, D.C.: World Resource Institute.

Toledo, V.M., and N. Barrera-Bassols. 2008. *La Memoria Biocultural: La Importancia Ecologica de Las Sabidurıas Tradicionales*. Barcelona, Spain: ICARIA. Retrieved August 25, 2012 (http://www.agroeco.org/socla).

Tropical Agricultural Research and Higher Education Center (CATIE). 2009. *Mesoamerican Agroenvironmental Program (MAP)*. Final Implementation Proposal. Turrialba, Costa Rica: CATIE. Retrieved December 10, 2013 (https://kgv.doffin.no/app/docmgmt/downloadPublicDocument.asp?DVID=110426&FMT=1&AT=15&ID=108775.)

Tropical Agricultural Research and Higher Education Center (CATIE). 2011. *Biennial Report 2010-2011*. Turrialba, Costa Rica: CATIE. Retrieved December 10, 2013 (http://www.iica.ac.cr/Esp/infoinstitucional/oRGANOS/CE/DocumentosTrabajo/CE2011/ING/Doc.%20sn%20CATIE-InfoBienal2010-2011.pdf.).

United Nations (UN). 2008. *Principles and Recommendations for Population and Housing Censuses*. Department of Economic and Social Affairs, Series M No.67, Rev.2. New York, NY: United Nations. Retrieved October 10, 2011 (http://unstats.un.org/unsd/default.htm).

United Nations (UN). 2010. *Rethinking Poverty: Report on the World Social Situation*. Department of Economic and Social Affairs, Social Policy and Development Division. Retrieved April 5, 2011 (http://social.un.org/index/Publications/tabid/83/news/11/Default.aspx).

Van Noordwijk, M., Leimona, B., Emerton, L., Tomich T.P., Velarde S.J., Kallesoe, M., Sekher, M., and Brent Swallow. 2007. "Criteria and indicators for Environmental Service Compensation and Reward Mechanisms: Realistic, Voluntary, Conditional and Pro-Poor". *CES Scoping Study Issue Paper no. 2. ICRAF Working Paper no. 37*. Nairobi, Kenya: World Agroforestry Centre. Retrieved September 25 (http://www.worldagroforestry.org).

Van Vliet, N., Mertz, O., Heinimann, A., Langanke, T., Pascual, U., Schmook, B., Adams, C., Schmidt-Vogt, D., Messerli, P., Leisz, S. J., Castella, J.C., Jørgensen, L., Birch-Thomsen, T., Hett, C., Bech-Bruun, T., Ickowitz, A., Vu, K.C., Yasuyuki, K., Fox, J., Padoch, C., Dressler, W., and A.D. Ziegler. 2012. "Trends, Drivers and Impacts of Changes in Swidden Cultivation in Tropical Forest-Agriculture Frontiers: A Global Assessment." *Global Environmental Change*, 22(2): 418-429.

Vandermeer, John. 1998. "Maximizing Crop Yield in Alley Crops." *Agroforestry Systems*, 40: 199-206.

Vandermeer, John and Ivette Perfecto. 2007. "The Agricultural Matrix and a Future Paradigm for Conservation." *Conservation Biology*, 21(1): 274-277.

Vedeld, P., Angelsen, A., Bojo, J., Sjaastad, E., and Gertrude K. Berg. 2007. "Forest Environmental Incomes and the Rural Poor." *Forest Policy and Economics*, 9(7): 869-879.

Walker, Thomas S. and N.S. Jodha. 1986. "How Small Farm Households Adapt to Risk." Pp. 17-34 in *Crop Insurance for Agricultural Development*, edited by P. Hazell, C. Pomareda and A. Valdez. Baltimore and London: John Hopkins University Press.

Wharton, Clifton R. 1969. "Subsistence Agriculture: Concepts and Scope." Pp. 12-22 in *Subsistence Agriculture and Economic Development*, edited by Clifton R. Wharton, Jr. New Brunswick, NJ: Transaction Publishers.

Wiebe, Keith. 1994. "Household Food Insecurity and Resource Use." In *International Agriculture and Trade Reports: Africa and the Middle East*. Washington, DC: ERS, USDA.

Wiebe , Keith. 2003. *Linking Land Quality, Agricultural Productivity, and Food Security.* USDA-ERS Agricultural Economic Report No. 823. Washington, D.C.: U.S. Department of Agriculture. Retrieved April 10, 2012 (http://www.ers.usda.gov/publications/aer-agricultural-economic-report/aer823.aspx.).

Wilk, Richard R. 1999. "Real Belizean Food: Building Local Identity in the Transnational Caribbean." *American Anthropologist*, New Series, 101(2): 244-255.

Wittman, H.K. and M.S. Johnson. 2008. "Fallow Management Practices in Guatemala's Western Highlands: Social Drivers and Biophysical Impacts." *Land Degradation and Development*,19: 178-189.

Wood, David and Jillian M. Lenne. 1997. "The Conservation of Agrobiodiversity On-farm: Questioning the Emerging Paradigm." *Biodiversity and Conservation*, 6: 109-129.

World Summit on Food Security (WSFS). 2009. *Declaration of the World Summit on Food Security.* Rome, 16-18 November 2009. Rome: FAO. Retrieved November 2, 2011 (http://www.fao.org/fileadmin/templates/wsfs/Summit/Docs/Final_Declaration/WSFS09_Declaration.pdf.).

World Bank (WB). 2008. *Agriculture for Development*. World Development Report 2008. Washington DC: The World Bank. Retrieved October 3, 2011 (http://siteresources.worldbank.org/INTWDR2008/Resources/WDR_00_book.pdf).

World Bank (WB). 2009. *Belize: Rapid Assessment of Agricultural Risks*. ACP Group of States and the European Commission. Washington DC: The World Bank. Retrieved June 20, 2012 (http://www.euacpcommodities.eu).

World Bank (WB). 2013. *Country Data: Belize*. Online Resources, The World Bank Group. Retrieved September 2, 2011 (http://data.worldbank.org/country/belize).

World Trade Organization (WTO). 2010. *Belize Trade Policy Review.* Trade Policy Review Body, WT/TPR/G/23. Retrieved February 6 2011 (http://www.wto.org/english/tratop_e/tpr_e/tp_rep_e.htm).

World Trade Organization (WTO). 2013. "Proposal No.3, Stockholding for Food Security, Interim 'Due Restraint'." In *Briefing Note: Agriculture Negotiations- the Bid to Harvest Low Hanging Fruit*. 9th WTO Ministerial Conference, Bali, 22 November. Retrieved April 6, 2013. (http://www.wto.org/english/thewto_e/minist_e/mc9_e/brief_agneg_e.htm#stockholding).

Wright, A.C.S., Romney, D.H., Arbuckle, R.H., and D.E. Vial. 1959. *Land in British Honduras: Report of the British Honduras Land Use Survey Team.* Colonial Research Publication, No 24. London, UK: Stationary Office.

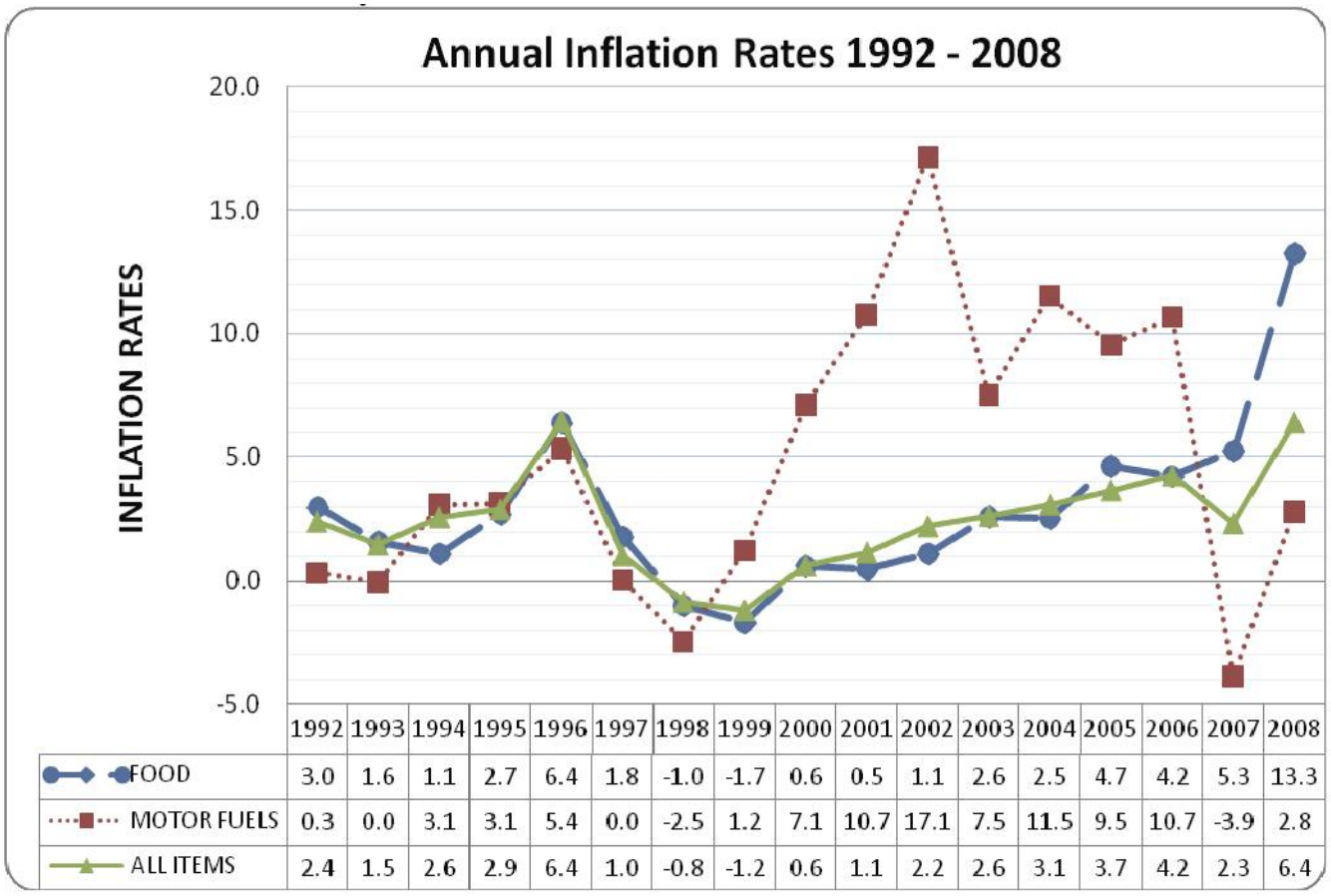
Yanggen, David and Thomas Reardon. 2001. "Kudzu Improved Fallows in the Peruvian Amazon." Pp. 213-232 in *Agricultural Technologies and Tropical Deforestation*, edited by A. Angelsen and D. Kaimowitz. Oxon, UK: CABI Publishing.

Zarger, Rebecca. 2009. "Mosaics of Maya Livelihoods: Readjusting to Local and Global Food Crises." NAPA Bulletin. *American Anthropological Association.* 32 (1): 130-151.

Zhang, W., Ricketts, T., Kremen, K., Carney K., and S. 2007. "Ecosystem Services and Disservices to Agriculture." *Ecological Economics*, 64(2): 253-260.

APPENDIX A

Food Price Inflation in Belize, 1992- 2008



	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
FOOD	3.0	1.6	1.1	2.7	6.4	1.8	-1.0	-1.7	0.6	0.5	1.1	2.6	2.5	4.7	4.2	5.3	13.3
MOTOR FUELS	0.3	0.0	3.1	3.1	5.4	0.0	-2.5	1.2	7.1	10.7	17.1	7.5	11.5	9.5	10.7	-3.9	2.8
ALL ITEMS	2.4	1.5	2.6	2.9	6.4	1.0	-0.8	-1.2	0.6	1.1	2.2	2.6	3.1	3.7	4.2	2.3	6.4

Source: Statistical Institute of Belize (2009b)

APPENDIX B

Imports of Selected Foods Groups as a Percentage of Domestic Supply

	Fruits	Milk	Vegetables	Cereals
Antigua and Barbuda	14.7	48.9	15.9	98.7
Bahamas	45.9	95.1	27.1	99.5
Barbados	78.9	78.4	28.5	110.4
Belize	0.3	86.3	25.9	29.2
Cuba	0.0	38.1	0.7	63.2
Dominica	0.1	54.9	9.7	97.7
Dominican Republic	0.9	11.5	1.2	65.0
Grenada	0.4	95.0	18.7	176.2
Guyana	0.5	61.4	14.1	19.5
Haiti	0.0	46.8	3.3	62.0
Jamaica	0.3	80.6	5.9	100.0
Saint Kitts and Nevis	33.8	81.5	68.7	100.0
Saint Lucia	0.6	94.5	76.4	100.0
Saint Vincent/Grenadines	0.4	86.6	13.8	205.9
Suriname	1.4	35.6	13.8	22.5
Trinidad and Tobago	11.6	95.5	50.4	103.9

Source: Deep Ford and Rawlins (2007)

APPENDIX C

Central Interview Questions

Date:

ID No:

Socio-economic and cultural factors

1) **Is your family from Santa Familia Village?**
   If no: When and from where did you come?
2) **How many members rely on this household for the majority of their food? ____**
3) **How many members contribute money, food, or other resources to support this household? ~ ____**

□ Others inside Belize □ Others Abroad □ Seasonal Jobs □ Informal work □ Sale of crops/livestock □ Timber sales

Association	**Age**	**Source**	**Location**	**Amount ($/hr) (hr/day) (Days/wk) (Mo/yr)**	**Ed**	**Time**	**Raises/Promotions**
1)				$__ /hr__/day__/wk___/yr=		____mo	/
Alternative Job:				$__ /hr__/day__/wk___/yr=			
2)				$__ /hr__/day__/wk___/yr=		____mo	/
Alternative Job:				$__ /hr__/day__/wk___/yr=			
3)				$__ /hr__/day__/wk___/yr=		____mo	/
Alternative Job:				$__ /hr__/day__/wk___/yr=			
4)				$ __ /hr__/day__/wk___/yr=		____mo	/
Alternative Job:				$__ /hr__/day__/wk___/yr=			
5)				$__ /hr__/day__/wk___/yr=		____mo	/
Alternative Job:				$__ /hr__/day__/wk___/yr=			
6)				$ __ /hr__/day__/wk___/yr=		____ mo	/

□ **Others Abroad** □ **Seasonal Ag** □ **Ag Industry** □ **Small Store** □ **Sale of livestock** □ **Sale of Crops**

□ **All contributing members currently living in this home?**

4) **Female head employed?** Y/N **Age: ___ Level of Ed**. ____
   __ /hr__/day__/wk___/yr=
   Interest or necessity?
   □ Sale of Garden/Milpa Food □ Sale of Processed Food □ Bordados □ Small Store □ Other:

5) **Security of Home Tenure:** □Leasing □ Leasing Process □ Titling Process □Title □Mortgaged property □Renting
   Other claimed/accessible land outside of home plot:
   Location: _____ Size_____ □ Leasing □ Leasing Process □ Titling Process □Title □ Mortgaged property □ Renting
   Location: _____ Size_____ □ Leasing □ Leasing Process □ Titling Process □Title □ Mortgaged property □ Renting
   Location: _____ Size_____ □ Leasing □ Leasing Process □ Titling Process □Title □ Mortgaged property □ Renting
   If in 'process,' what is central obstacle to securing tenure? _____

[Woman]

6) **Is your family able to save money on a consistent basis without having to use the majority?**

7) **Have you ever sold assets, such as land, that you otherwise would not sell in order to obtain needed money?** S/N
If Yes, How many times? ____ Total acreage: _____
Other sources to financial capital to which the family has access: _____ times used:_____

8) **Have you ever had to cut the size of meals because there was not enough food to eat**? Y/N
If Yes, are you having to do so more now than in the past? Y/N
Why?

9) **Resource Access and Origin:**

Firewood__/wk__/12: □ Village Market □ Cayo Market □ Village Land w/o pay_Fam_Other □ HHPlot □ Other HHLand

□ Private Bush Land w/o pay- Extd.Fam/Other □ Private Bush Land w/pay- Extd.Fam/Other □Unclaimed/Gov/Public

Timber Bldg Materials__/12: □ Cayo Market □ HHPlot □ Other HHLand □ Village Land w/o pay □ Village Land w/pay

□ Private Bush Land w/o pay- Extd.Fam/Other □ Private Bush Land w/pay- Extd.Fam/Other □Unclaimed/Gov/Public

10) **How many days per week does your family consume the following:**

Resource	**Origin & Rate Purchased**	**Origin & Rate Produced**	**Distribution and Provision**
□ Oil (imp/coco/cah):	__/week ___/12	bought in /grown in G M and provides___ /weeks___12	□ plus shares for: other family) ∞ d___/mo
□ Sugar:	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d___/mo □
Coffee:	__/week ___/12	bought in	□ plus shares for: other family) ∞ d___/mo
□ Milk (not creamer) pd/can/fsh:	__/week ___/ 12	bought in /grown in M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d ___/mo
□ Maza:	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d ___/mo
□ Corn Tortilas:	___/week ___/12	bought in	□ plus shares for: other family) ∞ d ___/mo
□ Bread swt/slt:	___/week ___/12	bought in	□ plus shares for: other family) ∞ d ___/mo
□ Cheese:	__ week __/12	bought in /made provides ___ /weeks___12	□ plus shares for: other family) ∞ d___/mo
□ Ramen:	__/week ___/12	bought in	□ plus shares for: other family) ∞ d___/mo
□ **Other canned/pkgd foods eaten regularly:**			
_____:	__week __/12	bought in	□ plus shares for: other family) ∞ d___/mo
_____:	__week __/12	bought in	□ plus shares for: other family) ∞ d___/mo
_____:	__week __/12	bought in	□ plus shares for: other family) ∞d ___/mo
□ Rice:	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d ___/mo
□ Beans:	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d ___/mo
□ White Flour:	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d ___/mo
□ Corn Grains:	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d ___/mo
□ **Other grains:**	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞d ___/mo
□ Eggs:	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d ___/mo
□ Chicken:	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d___/mo
□ Pork:	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d___/mo
□ Beef:	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d___/mo
□ Goat/Sheep:	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d___/mo
□ Fish:	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d___/mo
□ Bush Meat (e.g. Venado, Faisan, Tepesquinte, Iguana, Wech etc.):			
___/week	___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d___/mo
□ **Other Meat:**	___/week ___/12	bought in /grown in G M and provides ___ /weeks___12	□ plus shares for: other family) ∞ d___/mo

□ Coco/Macal: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Cassava: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d __/mo □
ChoCho: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Potato: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo □
Swt Potato/Yam: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Carrots: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo □
Ayote/Siquil/Zuccini: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo □
Okra: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo □
Tomato: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Cucumber: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d ___/mo
□ Cabbage: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d ___/mo
□ Lettuce: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d ___/mo
□ Chaya: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo □
Calaloo: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Hierba de Mora: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Spinach: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Chib: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ **Other vegetables/leafy greens/nuts:** (e.g. string beens, almonds etc.)
___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d ___/mo □
Plantain: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d ___/mo
□ Banana/Blogo: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d ___/mo
□ Habanero/Other: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d ___/mo
□ Coconut/water: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Avocado: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d ___/mo
□ Mango: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d ___/mo
□ Papaya: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d ___/mo
□ Bread fruit/nut: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Orange/Mandarin: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Grapefruit: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Sour Sop/Guanabano: ___/week __/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Lime: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Pineapple: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Sandilla/Melon: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Hocóte/Siruela/Plum: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d ___/mo
□ Anona/Custard Apple: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Nance/Craboo: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Lima: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Bukut/Stinking Toe: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo □
Mamey: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo □
Caimito/Star Apple: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Blackberry/Mulb/Gooseb: ___/week ___/12 bought in /grown in G M and provides ___ /weeks__12 □ plus shares for: other family) ∞ d___/mo
□ Chico Zapote: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Cashew: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Tamarindo: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Guaya/Kinip: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ Guayaba/Guava: ___/week ___/12 bought in /grown in G M and provides ___ /weeks___12 □ plus shares for: other family) ∞ d___/mo
□ **Other Fruits:** (e.g. Passion Fruit, Cocoyol, Cherry, Siquiya, Chapulín, Coconobuay, Tukhi, Sokotz, Ziricote etc.)

Assessment of Maintenance of Garden: Y/N □ If Yes, use [Field Guide for Garden Conditions]

11) Total number of cropping sites to which the HH has access (excluding home garden): _____

12) Current number in use over last year: _____

13) If None: Farmed in the past? **Y/N**

Most Recent Year: _____ Size of farm: _____
Central reasons for stopping:_____
Have government policies influenced your choices? **Y/N** In what way?

Enhancing Household Food Production Practices

14) Are you planting or planning on planting more food for family consumption today than in the past? Y/N

Why or why not?

15) Are you planting or planning on planting more food to sell in the market than in the past? Y/N

Why or Why Not:

16) What do you consider your family´s major **challenges** to improving food production capacity?

Husband/wife/children have interest intensifying production on milpa/in lot?

17) What do you consider as your family's **opportunities/assets** for improving food production capacity?

18) Are there any farming methods that your family would like to know more about to improve conditions on your land? Y/N

19) Do you currently know of any outlets where you can receive training in low-input agricultural practices? Y/N

20) Do you or have you belonged to any farmer organizations in or outside of the village? Y/N
Why or why not?

Entrevista Central **Fecha:**

ID No:

Factores socio-económicos y culturales

1) **Es su familia originalmente de Santa Familia?**
   Si no: Cuando y de dónde vinieron?
2) **Cuántos miembros depende en ésta casa para la mayoría de su comida?** ____
3) **Cuantos contribuyen dinero, comida, u otros recursos para apoyar a la casa?** ____

□ Otros dentro de Belize □ Otros afuera del país □ Ganancias de temporada □ Trabajo informal □ Venta de cosechas/ganado □ Madera

Asociación Edad Fuente Ubicación Cantidad ($/hra) (hras/día) (Días/sma) (mez/año) Ed Tiempo Aumentos/Promoción

1) $__ /hra__/día__/sma___/año= ____ms/año /

Trabajo Alternativa: $__ /hra__/día__/sma___/año=

2) $__ /hra__/día__/sma___/año= ____ ms/año /

Trabajo Alternativa: $__ /hra__/día__/sma___/año=

3) $__ /hra__/día__/sma___/año= ____ ms/año /

Trabajo Alternativa: $__ /hra__/día__/sma___/año=

4) $__ /hra__/día__/sma___/año= ____ ms/año /

Trabajo Alternativa: $__ /hra__/día__/sma___/año=

5) $__ /hra__/día__/sma___/año= ____ ms/año /

Trabajo Alternativa: $__ /hra__/día__/sma___/año=

6) $__ /hra__/día__/sma___/año= ____ ms/año /

□ **Otros afuera** □ **Temp de Frijol/Naranja** □ **Agroindustria** □ **Tiendita** □ **Venta de Ganado** □**Venta de Cosecha**

□ **Todos contribuyendo viven en la casa?**

4) **Señora de la casa empleada?** S/N **Edad: ___ Nivel de Ed**. ____
   $__ /hra__/día__/sma___/año=
   Interés o necesidad?
   □ Venta de comida del jardín/milpa □ Venta de comidas procesadas □ Venta de Bordados □ Tiendita □ Otro:

5) **Seguridad de Terreno:** □Arrendando □Proceso de Arrendar □Proceso de Titular □Titulado □Propiedad Hipotecado □Rentando

Otros terrenos reclamados/accesibles además del lote:

Ubicación: _____Tamaño_____ □Arrendando □Proceso de Arrendar □Proceso de Titular □Titulado □Propiedad Hipotecado □Rentando
Ubicación: _____Tamaño_____ □Arrendando □Proceso de Arrendar □Proceso de Titular □Titulado □Propiedad Hipotecado □Rentando
Ubicación: _____Tamaño_____ □Arrendando □Proceso de Arrendar □Proceso de Titular □Titulado □Propiedad Hipotecado □Rentando

Si todavía en 'proceso,' obstáculo central para asegurar terreno? _____

[Mujer]

6) **Es la familia capaz de ahorrar dinero constantemente sin tener que usar la mayoría?**

7) **Han vendido bienes, como terreno, que de otra manera no iba a vender para acceder dinero que necesitaba? S/N**
Si Sí, ¿Cuántas veces? ____ Acres totales: _____
Otros Fuentes que tiene la familia para acceder dinero: _____ Veces utilizado: _____

8) **Han tenido que reducir la cantidad de lo que comen porque no había suficiente para comer?** S/N
Si Sí, ¿Lo tiene que hacer más hoy en día que en el pasado? S/N
¿Por Qué?

9) **Acceso y Origen de los Recursos:**

Leña__/sma__/12: □Mercado Aldea □Mercado Cayo □Terreno de la Aldea sin pago_Fam_Otro □Terreno de lote □ Terreno personal

□ Terreno de Monte Privado sin pagar- Fam Ext/Otro □ Terreno de Monte Privado con pago- Fam Ext/Otro □Terreno No rec/Gob/Publico

Materiales de monte para construir__/12: □Mercado Cayo □Terreno de Lote □ Terreno personal □Mercado de la Aldea pago/sin pago

□ Terreno de Monte Privado sin pago- Fam Ext/Otro □ Terreno de Monte Privado con pago- Fam Ext/Otro □Terreno No rec/Gob/Publico

10) **Cuántos días por semana consume la familia lo siguiente:**

Recurso	**Origen y Tasa de Compra**	**Origen y Tasa Producido**	**Distribución y Provisión**
□ Aceite(imp/coco/cor):	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Azúcar:	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Café:	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Leche (excl polvo para cafe) pol/lat/frs:	__/sm __/12 comp en	/hecho en J M proporcionando__ /sma__12	□con provisiones: otro/ familia)∞ d___/ms
□ Maza:	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Tortilla de Maíz:	__/sm ___/12 comprado en		□con provisiones para: otro/ familia) ∞ d___/ms
□ Pan dulce/salado:	__/sm ___/12 comprado en		□con provisiones para: otro/ familia) ∞ d___/ms
□ Queso:	__/sm ___/12 comprado en	/hecho en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Ramen:	__/sm ___/12 comprado en		□con provisiones para: otro/ familia) ∞ d___/ms
□ **Otras cosas de lata/paquete comido regularmente:**			
_____:	__semana __/12 comprado en		□con provisiones para: otro/ familia) ∞ d___/ms
_____:	__semana __/12 comprado en		□con provisiones para: otro/ familia) ∞ d___/ms
_____:	__semana__/12 comprado en		□con provisiones para: otro/ familia) ∞ d___/ms
□ Arroz:	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Frijol:	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Harina:	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Grano de Maíz:	___/__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ **Otros granos:**	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Huevo:	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Pollo:	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□Marano:	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Res:	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Cabra/Borrego:	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Pescado:	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ Carne de Monte (e.g. Venado, Faisán, Tepezcuinte, Iguana, Wech etc.):			
__/sm ___/12 comprado en		/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms
□ **Otras Carnes:**	__/sm ___/12 comprado en	/crecido en J M proporcionando___ /sma___12	□con provisiones para: otro/ familia) ∞ d___/ms

□ Coco/Macal __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Yuca/Casaba: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Chochó/Chayote: ___/__/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Papas: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Camote/Ñame: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Zanahoria: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Ayote/Siquíl/Zuccini:__/__/sm ___/12 comprado /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Ocoro: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Tomate: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Pepino: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Repollo: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Lechuga: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Chaya: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Calaloo: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Hierba de Mora: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Espinaca: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Chib: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ **Otros vegetales/hojas verdes/nueces:** (e.g. frijoles verdes, almendras etc.)
__/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Plátano: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Guineo/Blogó: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Habanero/Otro: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Coco (carnaza/agua): __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Aguacate: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Mango: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Papaya: ___/__/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Mazapanes: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Naranja/Mandarina: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Toronja: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Guanábano: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Limón: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Piña: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Sandilla/Melon: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Hocóte/Ciruela: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Anona: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Nance: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Lima: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Bukút: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Mamey: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Caimito: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/m
□ Blackberry/Mulb/Gooseb: __/sm __/12 comprado en /crecido en J M proporcionando__/sma__12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Chico Zapote: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Marañón: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Tamarindo: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Guaya/Kiníp: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ Guayaba: __/sm ___/12 comprado en /crecido en J M proporcionando___ /sma___12 □con provisiones para: otro/ familia) ∞ d___/ms
□ **Otras Frutas:** (e.g. Maracuya, Cocoyól, 'Cherry', Siquiyá, Chapulín, Coconobuay, Tukhí, Sokotz, Ziricóte etc.)

Evaluación del mantenimiento de jardín: S/N □ Si Sí, usar [Guía de Campo para Jardín]

11) Número total de sitios a que tiene acceso la familia para sembrar (excluyendo jardín): _____

12) Sitios utilizados durante el último año: _____

13) Si No: Sembraba en el pasado? **Y/N**

Año más reciente: _____ Tamaño de la Milpa: _____
Razones centrales por parar:_____
Han influido su decisión las políticas del gobierno? **S/N** ¿En qué manera?

Mejorando las Prácticas de Producción

14) Está sembrando, o planeando a sembrar, más comida para el uso de la familia hoy en día que en el pasado? S/N

¿Por Qué Sí o Por Qué No?

15) Está sembrando, o planeando a sembrar, más comida para vender en el mercado que en el pasado? S/N

¿Por Qué Sí o Por Qué No?

16) Qué considera Ud. los **obstáculos** más grandes que enfrenta la familia para mejorar su capacidad de producción?

Señor/señora/hijos tienen interés en intensificar producción en la milpa/lote?

17) Que considera Ud. las **oportunidades/bienes** que tiene la familia para mejorar su capacidad de producción?

18) Hay algún método agrícola sobre que la familia quisiera conocer más para mejorar las condiciones en sus terrenos? Y/N

19) Ud. conoce actualmente algún lugar/servicio donde uno puede recibir entrenamiento en prácticas agrícolas de bajo costo y bajo uso de agroquímicos? Y/N

20) Ud. es ó ha sido miembro de una organización agrícola dentro o afuera de la aldea? S/N
¿Por Qué Sí o Por Qué No?

APPENDIX D

Garden Field Guide

ID No: ` **Date:**

Observation Type: □ On site □ Vantage observation □ Interview

Days of labor: /wk-mo /12= yr **Main Garden Tenders:**

Topography: □ Flat □ Slope Steepness:

Crop Types (Quantity, Source w, w/o pay, Income, Location of Sale, Provisions):

Grains:	(Q S I L P)	(Q S I L P)	(Q S I L P)	(Q S I L P)
Vegetables/Root:	(Q S I L P)	(Q S I L P)	(Q S I L P)	(Q S I L P)
(Q S I L P)	(Q S I L P)	(Q S I L P)	(Q S I L P)	(Q S I L P)
(Q S I L P)	(Q S I L P)	(Q S I L P)	(Q S I L P)	(Q S I L P)
Fruits:	(Q S I L P)	(Q S I L P)	(Q S I L P)	(Q S I L P)
	(Q S I L P)	(Q S I L P)	(Q S I L P)	(Q S I L P)
	(Q S I L P)	(Q S I L P)	(Q S I L P)	(Q S I L P)
Herbs:	(Q S I L P)	(Q S I L P)	(Q S I L P)	(Q S I L P)
	(Q S I L P)	(Q S I L P)	(Q S I L P)	(Q S I L P)

Land Cover: ____% Grass ____%other Herbaceous ___ %Litter ___%Rock ____% Tree Fall ___ %Water

Canopy Height: ~____ ft. **Canopy Closure:** ___ % closure

What do you think about your overall production?

What do you think about the quality of your soil?

□ Black □ Red □ Yellow □ White

Do you have any problems with pests/diseases?

Mode of Irrigation: □ Pipe/Hose □ Bucket □ Rain □ Other: **Distance to Source:**_____

How do you prepare/maintain your land for planting?

Main Tools: □ Machete □ Stick □ Hoe □ Fire □ Other:

Inputs: □ Synthetic Pest/Herb/gal: □ Org Pest/Herb/gal:
□ Synthetic Ferts/lb: □ Org Ferts/lb:
□ Other

Do you use hybrid seeds often, why or why not?

Crops Sold:

Crop	Season Sold	Price during San José/Yashkin	Buyer	Alt Buyer	Total Income/yr	Reflection on Price

Animals Raised: Cash Value Land Use Off-farm food input Source/Location

( )

( )

( )

Other crops you would like to plant in future? Family or Sale?

Challenges to planting such crops in the home site:

Reasons for maintaining a garden?

Guía de Campo para Jardín

ID No: ` **Fecha:**

Clase de Observación: □ En sitio □ Observación de vista □ Entrevista

Mantenimiento: /sma-ms /12= año **Mantenedores centrales:**

Topografía: □ Planada □ Pendiente:

Cosechas (Cantidad, Fuente con/sin pago, Ingreso, Ubicación de venta, Provisiones):

Granos:	(C F I U P)	(C F I U P)	(C F I U P)	(C F I U P)
Vegetables:	(C F I U P)	(C F I U P)	(C F I U P)	(C F I U P)
(C F I L P)	(C F I U P)	(C F I U P)	(C F I U P)	(C F I U P)
(C F I L P)	(C F I U P)	(C F I U P)	(C F I U P)	(C F I U P)
Frutas:	(C F I U P)	(C F I U P)	(C F I U P)	(C F I U P)
	(C F I U P)	(C F I U P)	(C F I U P)	(C F I U P)
	(C F I U P)	(C F I U P)	(C F I U P)	(C F I U P)
Hierbas:	(C F I U P)	(C F I U P)	(C F I U P)	(C F I U P)

Cubierta Terrestre: ____% Zacate ___%otro Herbáceos ___ %Basura orgánica ___%Piedra ____%Árboles caídos ___ %Agua

Altura de la fronda: ~____ ft. **Cierre de Copas:** ___ %

Que Ud. opina sobre la calidad de la producción de sus cosechas?

Que Ud. opina sobre la calidad de la tierra?

□ Negro □ Colorado □ Amarillo □ Blanco

Tiene problemas con plagas/enfermedades?

Modo de Irrigación: □ Tubo/Manguera □ Cubeta □ Lluvia □ Otro: **Distancia al fuente:**_____

Como Ud. prepara/mantiene su terreno para sembrar en el lote?

Herramientas Centrales: □ Machete □ Macana □ Azadón □ Fuego □ Otro:
□ Pest/Herb sintética/gal: □ Pest/Herb orgánica/gal:
□ Abono sintética/lb: □ Abono orgánica/lb:

Ud. siembra semilla híbrido regularmente? ¿Por Qué Sí o Por Qué No?

Cosechas de Venta:

Cosecha	Precio del Temporada	Precio San José/Yashkín	Comprador	Comprador Alt	Ingreso Total/año	Reflexión del precio

Animales Criados:	Valor Económico	Terreno Utilizado	Costo de Comida/ms	Lugar de Compras
( )				
( )				
( )				

Cosechas que quisiera sembrar en el futuro? Familia o Venta?

Obstáculos para sembrar tales cosechas en el jardín/lote:

Razones para mantener jardín?

APPENDIX E

Milpa Field Guide

ID No: ` **Obs Type:** On site □ Vantage observation □ Interview **Date:**

Main Farmer: Y/N **Years Farming? ____** **Location: _____**

Elevation: □ Lowland □ Upland

Topography: □ Flat □ Slope Steepness:

Land Cover: ____% Grasses ___ %Shrubs ____%Litter ___%Rock ____% Tree Fall ___ %Water

Canopy Closure: ___ % closure, Canopy Height: ~____ ft. **DHB Canopy:** 20-30cm, 30-40cm, 40-50cm, 50-60cm, 70-80cm

Land Use Type: □ Milpa planned for ___ years, burning every ___ years, with ___ year fallow, or converted to:

□ Permanent Farm (Bare/Covered) with ___ fallow, with burning every __year?

Current usage: 1st 2nd 3rd 4th 5th > 5 years □ San José (March) □ Cosecha (May/June) □ Yashkin (September)

Total Cropped Area: _____ **Rotate crops on site? _____**

Crop Types (**A**rea, **Q**uantity/100lb, **S**eed Source w-w/o pay, **I**ncome, **L**ocation of Sale, **P**rovisions)**:**

Grains by 100lb sack:	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)
Meat/eggs:	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)	(AQ S IL P)
Vegetables/Roots:	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)	(AQ S I LP)
	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)
	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)
Fruits:	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)
	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)
	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)	(AQ S I LP)
Herbs/Spices:	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)	(AQ S I L P)

Previous Vegetation: Open/Bare, Pasture, Cañada (1-5), Guamil (5-10), Bush (10-20), High Bush (20+)
Cropping Season of Main Crops:

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

What influences your crop choices?
Ideal soil/slope conditions for main crops?
Using hybrid seed varieties, why or why not?

Days per week dedicated to the farm over the months? Jan Feb Mar Apr May Jun July Aug Sept Oct Nov Dec

How many days do you require additional labor on your farm over the months? Labor amount, source/ compensation

Distance to main road: **Seasonally passable:** Y/N

Mode of daily transportation: **During harvest:** **Owner:**

Mode of Irrigation: □ Rain □ Bucket □ Other Irrigation: **Distance to water source: _____**

What do you think about the quality of your soil (problems?)

□ Black (soft or hard) □ Red □ Yellow □White

What do you think about your overall production?

Plant by moon cycles? Y/N Why or why not?

How do you prepare your land for planting?

When cleared: **When burned:** **Time of Day Burned:** **How hot?**

- **Main Tools:** □ Stick (macana) □ Hoe (azadón) □ Machete □ Fire □ Other
- **Inputs:** □ Synthetic Pest-Herb/gal: □ Org Pest-Herb/gal:
- □ Synthetic Ferts/lb: □ Org Ferts/lb:

□ Other Maintenance practices:

Percent loss to pests, disease, or livestock?
How are crops stored?
Percent loss in storage?

Cash Crop	**Season Sold**	**Price in Dry Season**	**Buyer**	**Alt Buyer?**	**Total Income/yr**	**Reflection on Price**

Number of Animals Raised: Cash Value Land Use Off-farm food input Source/Location

Reasons family engages in food production?

Reasons for shifting cultivation instead of creating permanent farm? (If Permanent-visa versa)

How has farming become easier or harder than in the past?

Have changes in government policies helped or hurt you over time? (e.g. Financial Access, Pricing Policies, Trade policies)

Guía del Campo para la Milpa

ID No: ` **Clase de Observación:** □ Sitio □ Observación de vista □ Entrevista **Fecha:**

Agricultor Central: Y/N **Años como agricultor? ____** **Ubicación: _____**

Elevación: □ Vega □ Montaña

Topografía: □ Planada □ Pendiente:

Cubierto Terrestre: ____% Zacates ___ % Arbustos ___%Basura Orgánica ___%Piedra ___% Árboles caídos ___ %Agua

Cierre de Copas: ___ % Altura de la Fronda: ~____ ft. **DHB Copas:** 20-30cm, 30-40cm, 40-50cm, 50-60cm, 70-80cm

Clase de Uso: □ Milpa planeado para ___ años, quemando cada ___ años, con ___ años de descanso, o convertido en:

□ Granja Fijo (Abierto/Cubierto) con ___ descanso, quemando cada __años?

Utilización Actual: 1st 2nd 3rd 4th 5th > 5 años □ San José (Marzo) □ Cosecha (Mayo/Junio) □ Yashkin (Septiembre)

Área total cosechada: _____ **Rotación de cosechas en el sitio? _____**

Cosechas (**A**rea, **C**antidad/100lb, **F**uente de Semilla con-sin pago, **I**ngreso, **U**bicación de Venta, **P**rovisiones)**:**

Granos por bulto:	(A C F I U P)	(A C F I U P)	(A C F I U P)	(A C F I U P)
Carne/Huevos:	(A C F I U P)	(A C F I U P)	(A C F I U P)	(A C F I U P)
Vegetables:	(A C F I U P)	(A C F I U P)	(A C F I U P)	(A C F I U P)
	(A C F I U P)	(A C F I U P)	(A C F I U P)	(A C F I U P)
	(A C F I U P)	(A C F I U P)	(A C F I U P)	(A C F I U P)
Frutas:	(A C F I U P)	(A C F I U P)	(A C F I U P)	(A C F I U P)
	(A C F I U P)	(A C F I U P)	(A C F I U P)	(A C F I U P)
	(A C F I U P)	(A C F I U P)	(A C F I U P)	(A C F I U P)
Hierbas:	(A C F I U P)	(A C F I U P)	(A C F I U P)	(A C F I U P)

Vegetación Anterior: Abierto, Potrero, Cañada (1-5), Guamil (5-10), Monte (10-20), Monte Alto (20+)
Temporada de Cosechas:

	En	**Feb**	**Mar**	**Abr**	**May**	**Jun**	**Jul**	**Ag**	**Sep**	**Oct**	**Nov**	**Dec**

Que afecta su decisión de sembrar tales cosechas?
Tierra/caída ideal para las cosechas?
Usando semillas híbridos, ¿Por Qué Sí o Por Qué No?

Días por semana dedicados a la milpa durante el año: En Feb Mar Abr May Jun July Ag Sept Oct Nov Dec
Cuántos días durante los diferentes meses requiere mano de obra adicional ? Cantidad, Fuente/ compensación

Distancia a la calle central: **Transitable durante la lluvia:** S/N
Modo diario de transportación: **Durante la Cosecha:** **Dueño:**

Modo de irrigación: □ Lluvia □ Cubeta □ Otra Forma: **Distancia al Fuente: _____**

Que Ud. opina sobre la calidad de su tierra (problemas?)
□ Negro (suave o duro) □ Colorado □ Amarillo □Blanco

Que opina Ud. sobre la producción de sus cosechas?

Siembra con la luna? S/N ¿Por Qué Sí o Por Que No?

Como prepara Ud. su terreno para sembrar?

Cuando se limpia: **Cuando se quema:** **Hora del Día:** **Temperatura?**

Herramientas Centrales:
□ Macana □ Azadón □ Machete □ Fuego □ Otra
□ Pest-Herb Sintética/gal: □ Pest-Herb Orgánica/gal:
□ Abono Sintética/lb: □ Abono Orgánico/lb:
□ Otras prácticas de mantenencia:

Porcentaje perdida a las plagas, enfermedades, animales salvajes, ganados?
Como se guarda la cosecha?
Porcentaje perdida en guardar?

Cosecha Precio/Temporada Precio durante verano Comprador Comprador Alt. Ingreso Total Reflexión en precio

Num. Animales Criados: Valor Económico Terreno Utilizado Costo de comida/ms Lugar de Compras

Razones por dedicarse a la milpa?

Razones por mover la milpa en vez de hacer una granja fijo? (Si es fijo-pregúntalo al revés)

Comparado al pasado, ha puesto más duro ó más fácil la agricultura con el tiempo?

Le ha afectado en una manera positiva o negativa algún cambio en las políticas del gobierno en relación a la agricultura? (e.g. Acceso Financiero, Políticas de Precio, Políticas del Comercio)

APPENDIX F

Retail Price Range for Selected Foods by Pound in San Ignacio Market

Product Type	Low	High	Product Type	Low	High
White Rice	1.25	1.75	Avocado	1.00ea	2.50ea
Red Beans	1.00	3.00	Mango	1.00ea	2.00ea
Black Beans	1.00	2.00	Papaya	1.50	2.00
Pinto Beans	1.50	2.00	Sour Sop	2.50	4.00
Black Eye	1.50	2.00	Pineapple	2.50ea	5.00ea
Yellow Corn	.45	.75	Coconut	1.00ea	1.50ea
White Corn	--	--	Habanero	1.00	2/.25cents
Cabbage	.75	1.50	Orange	10/1.00	3/1.00
Tomato	1.00	3.00	Grapefruit	5/1.00	5/1.00
Cucumber	.50	2.00	Lime	5/1,00	3/1.00
Carrots	1.00	1.50	Plantain	4/1.00	3/1.00
Sweet Pepper	2.00	10.00	Bananas	1.00/hand	1.50/hand
Okra	1.00	2.00	Guaya	1.00/bag	1.00/bag
Irish Potato	1.25	2.00	Nance	1.00/bag	1.00/bag
Sweet Potato	1.00	1.50	Melons	.50	.60
Cassava	.50	1.50	Anona	1.50ea	2.00ea
Taro	1.00	2.00	Mamey	1.00ea	1.50ea
Chayote	1.00	2.00	Chico Zapote	2.00ea	2.00ea
Squash	.75	2.00	Caimito	4/1.00	3/1.00
Lettuce	2.00	4.00	Tamarind	2.00	2.00
Chaya	1.00/bag	1.00/bag	Guava	1.00/bag	1.00/bag
Mora	1.00/bag	1.00/bag	Chib	2.00bunch	3.00bunch

Price variations reflected through Jan 1 to Dec 31, 2012 in BZD dollars
Source: Informant 7, San Ignacio merchant, personal communication, December 19, 2013

APPENDIX G

Fraudulent eviction letter to land tenure insecure farmer with long-term resource claim

193 Western Highway
P.O. Box 236
Santa Elena Town
Cayo District, Belize
Tel: 501-824-2355

4B Richard Street,
Belize City, Belize
P.O. Box. 1373
Tel: 501-633-0920

11th September, 2012

[redacted]
Duck Run III
Cayo District
Belize

WITHOUT PREJUDICE

Dear Sir,

Re: Notice To Vacate – Block No. 3, Duck Run III, Cayo District, Belize – Property of Finca Santa Familia Ltd.

I write on behalf of Finca Santa Familia Ltd. a company duly incorporated under the Companies Act of Belize Revised Edition 2000, with is registered office at No. 35 Barrack Road, Belize City, Belize; (hereinafter called 'the company').

The company has instructed that it is the lawful owner of the registered property mentioned above. (Enclosed is a copy of the conveyance and relevant plan).

It is obvious that you are illegally occupying the company's property, either knowingly or by mistake.

The company has decided that it does not wish to get anyone in trouble and would prefer that you leave or vacate the said land voluntarily.

Through this letter therefore you are urged to leave/vacate the property no later than 30th November, 2012.

Please let my office know within two (2) weeks of receiving this letter what your decision is. If necessary the company is prepared to make a reasonable extension of the time for you to leave/the said land.

The company is prepared to consider to compensation in lieu of you moving your crops.

If you need to discuss this matter please feel free to call my office and I would be happy to arrange a free appointment.

It is the hope of the company to settle this matter in an amicable way and avoid going to court as doing so would require you to pay my client high court and lawyer fees.

Sincerely,

Orlando A. Fernandez
Attorney-at-Law
Finca Santa Familia Ltd. & Estevan Lopez Property Matter.11.9.12

Orlando's Document –OAF 2012 Doc – Letters

APPENDIX H

2012 Purchasing Price for Selected Agricultural Products by 100 Pound Sack

	Reimer's Feed Mill & Country Foods (Spanish Lookout)		**Bel-Car** (Spanish Lookout)		**San Ignacio** (Market & Tortilla Mills)		**Villages** (by 100 ears)	
Product Type	**Low**	**High**	**Low**	**High**	**Low**	**High**	**Low**	**High**
Yellow Corn	23.00	32.00	25.00	27.00	--	35.00		
White Corn	--	--	27.00	35.00	35.00	60.00		
Red Kidney Beans	135.00	170.00	120.00	160.00	100.00	150.00	--	--
Black Beans	125.00	170.00	120.00	150.00	100.00	150.00	--	--
Black Eye Beans	--	--	65.00	80.00	--	--	--	--
Soy Beans	53.00	63.00	--	--	--	--	--	--
Local Beans	--	--	--	--				
Pepitoria	--	--	--	--	350.00	400.00		
Peanuts	--	--	--	--	100.00	125.00		

Price variations through Jan 1 to Dec 31, 2012 in BZD dollars
Prices offered by Bel-Car represent minimum prices where contracted farmers may gain higher returns over the year.

Sources:
Kenton Plett, Reimer's Feed Mill, Proprietor, personal communication, November 29, 2012.
Otto Friesen, Bel-Car, Proprietor, personal communication, August 13,2013.
Store Manager, Midwest Steel & Agro Supplies, Novermber29, 2012
Store representative, Country Foods, personal communication August 13, 2013
Informant 7, San Ignacio merchant, personal communication, September 19, 2013
Informant 4, commercial white corn producer, personal communication, May 20, 2012.
Informant 6, commercial hybrid corn producer, personal communication, September 31, 2012.

APPENDIX I

Selected Agricultural Input Price Range: Spanish Lookout and San Ignacio

Seed Inputs	**Spanish Lookout**		**San Ignacio**	
	Low	**High**	**Low**	**High**
Yellow Corn* (Pioneer)	4.60lb	10.00lb	6.00lb	--
Sweet Corn	--	56.25lb	--	--
White Corn* (Pioneer)	7.84lb	6.48lb	6.96lb	--
Red Kidney Beans	2.00lb	--	2.00lb	
Black Beans	1.05lb	--	1.00lb	1.75lb
Rice	n/a	n/a		
Cabbage	14.00 (.25oz)	68.75 (.25oz)	14.00(.25oz)	62.50(.25oz)
Tomato	13.00 (.25oz)	305.5 (.25oz)	12.00(.25oz)	370 (.167oz)
Cucumber	12.00oz	15.00oz	7oz	32.50oz
Sweet pepper	15.00oz	--	14.00oz	145 (.25oz)
Okra	2.25oz	--	3.00oz	4.00oz
Lettuce	8.70 (.25oz)	--	3.00 (20count)	83.00 (2.5g)
Squash	15.00oz	--	--	--
Melons	38.00oz	93.00oz	--	48.50oz

Prices in BZD dollars as of Nov 29, 2012; GST (12.5%) exempt.
**The Ministry of Agriculture & Fisheries at Central Farm also sells improved open pollinated corn seed starting at BZD $1.00/lb.*

Source: Mid-West Steel, Spanish Lookout; Jiron Agro Supplies, San Ignacio; Fab's Agro Supplies.
Anil Sinha, CARDIE Country Representative, personal communication, Nov 20, 2012)

Agrochemicals- Corn	Spanish Lookout	San Ignacio
Glyphosate 36SC	34.20 gal	--
24D	33.55 gal	--
Gramoxone	44.10 gal	
Remax	--	36.95 gal
Sulban 48	23.25 lt	--
Orius 25 EW	98.60 lt	96.50 lt
Chlorfluba	21.00 lt	--
Atrazine 90 WG	225.00 (25lbs)	--

Prices in BZD dollars as of Nov 29, 2012; GST (12.5%) exempt, but not duty free.
Source: Mid-West Steel, Spanish Lookout; Jiron Agro Supplies, San Ignacio.

Agrochemicals- Beans	Spanish Lookout	San Ignacio
Glyphosate 36 SC	34.20 gal	--
Sulban 48 EC	23.25 lt	--
Orius 25 EW	98.60 lt	--
Labaflua 15 EC	32.90 lt	--
Manco WP	14.25 kg	--
Flex 25 SL	70.50 lt	--

Prices in BZD dollars as of Nov 29, 2012; GST (12.5%) exempt, but not duty free.
Source: Mid-West Steel, Spanish Lookout.

Agrochemicals- Vegetables	Spanish Lookout	San Ignacio
Tryclan	44.40 (200g)	--
New Mectin 1.8 EC	98.00 (250cc)	--
Confidor 70 WG	16.15 (13g)	--
Atracol 70 WP	27.50 (750g)	--
Neem X	89.45 lt	--

Prices in BZD dollars as of Nov 29, 2012; GST (12.5%) exempt, but not duty free.
Source: Mid-West Steel, Spanish Lookout.

Fertilizer Input	Spanish Lookout	San Ignacio
Complete Fertilizer (Prosser)	82.50 (110lb)	.85-.95lb or 73-80.50 (110lb)
Complete Fertilizer (Pelicano)	64.00 (110lb)	--
Local Organic Fertilizers	Not marketed	Not marketed

Prices in BZD dollars as of Nov 29 2012; GST exempt and duty free.

Petrol Inputs	Price as of March, 13 2013
Regular Gas	11.80 gal
Diesel	10.71 gal

Prices based out of Belize City in BZD dollars as of March 13, 103 includes commercial margins and government taxes. Source: Belize Ministry of Finance, 2013. GST (12.5%) exempt if farmer grosses over BZD 75,000.00 per year.

Mechanical Inputs	Estimated Retail Price (before taxes)	Condition
Massey Ferg 4x4 Tractor 481	39,000.000	New
Ford 3 Bottom Plow	1,950.00	Second Hand
John Deere 6 Row Planter	4,000.00	Second Hand
Combine International 1460	21,500.00	Second Hand
John Deere 6 row header 1460	16,000.00	Second Hand

Based on minimum estimated price. Duty free, GST (12.5%) exempt if farmer grosses over BZD 75, 000.00 per year. Source: Crossroad Farm Supplies, Spanish Lookout, October, 2013.